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CIVIL ENGINEERING

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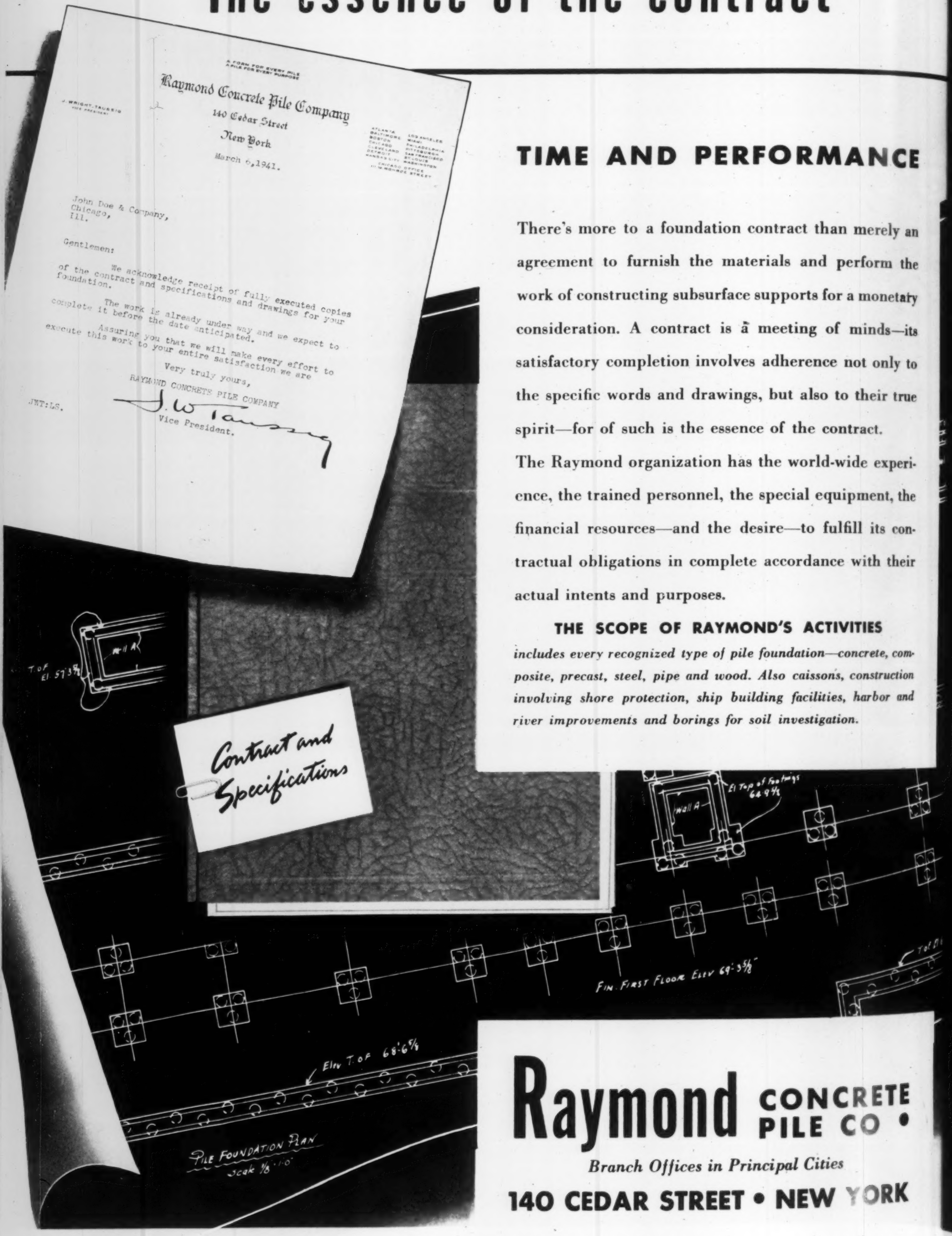
American Society of Civil Engineers

Across Sacramento Valley at Shasta Dam, from Near Construction Head Tower, Which Is 460 Ft High—See Page 350

Volume 11 *Number 6*

JUNE 1941

The essence of the contract



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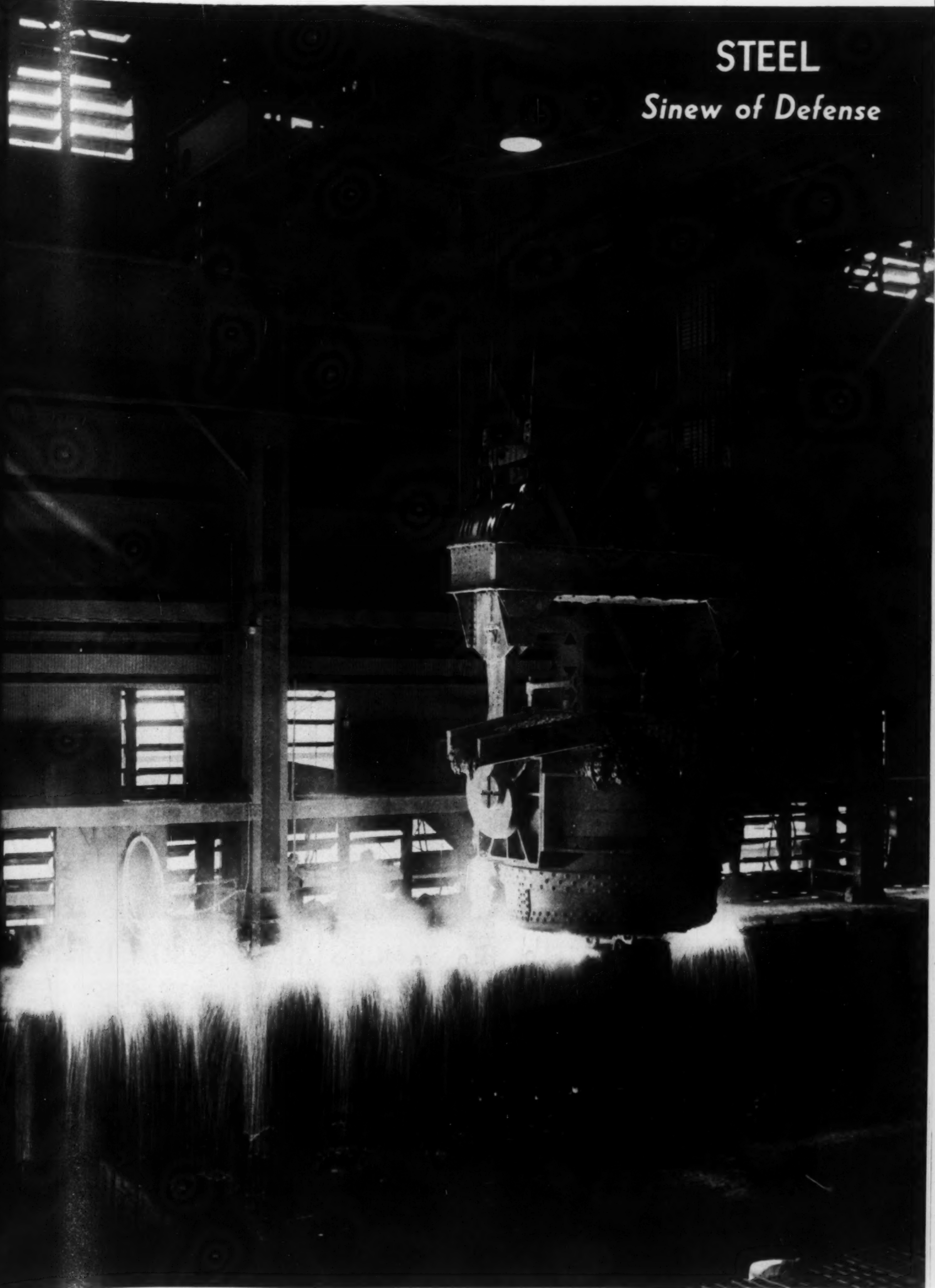

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20-FOOT DIAMETER PENSTOCKS AT DENISON DAM

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Among Our Writers

Sidney D. Kirkpatrick (B.S. in Chemical Engineering, U. of Ill., '16) served in the A.E.F. and on technical studies for the U.S. Tariff Commission. He joined the McGraw-Hill Publishing Co. in 1921, and became editor and director of the subsidiary, McGraw-Hill Book Co. He is vice-president of the Amer. Inst. of Chemical Engrs. and chairman of the Committee on Professional Training of E.C.P.D.

H. F. Doeleman (Royal Inst. of Engrs., Amsterdam, The Netherlands) came to the U.S. following graduation, and was for 10 years with the U.S. Steel Corp., becoming chief engineer of the Baltimore plant of the Carnegie Steel Co. Since 1913 he has been a consulting engineer. With an interim of war service as Major in the Construction Division, he later became Lt. Colonel, U.S. Reserve.

Philip B. Fleming (U.S. Military Academy, '11) served during the World War as colonel, subsequently reverting to his permanent rank of captain. He was promoted to Major in 1920, Lt. Col. in 1935, Col. in 1940, and in 1941 to Brig.-Gen. During his service in the Corps of Engineers, he has been stationed in all parts of the country.

C. R. Moore (Virginia Poly. Inst., B.S., '16, Electrical Engr., '17) was commissioned in the Army in '17, and after 4 years abroad had troop assignments at Forts Sam Houston and Du Pont and graduated from the Engineer School, Command and General Staff School, and Army War College. After work in the Boston District and the Office of the Chief of Engineers, he was made District Engr. in Portland, Ore., in 1938.

Nicholls W. Bowden (La. State U. '08; C.E. '28) has spent about 20 years with the Corp of Engineers, in the Chattanooga and Nashville (Tenn.) and Pittsburgh (Pa.) Districts on navigation, flood control, and hydroelectric projects. He was also in state highway work in La. for 6 years, and became state highway engineer in 1927. He has held his present position with the TVA since 1926 and has been water consultant for the National Resources Planning Board in the Tennessee and Cumberland River basins.

William N. Carey (U. of Minn., '13) after early railway and river improvement work, joined the Army in 1917. Discharged as a Major he became a Colonel in the Reserve. He served the City of St. Paul for 10 years, ending as city engineer. After being in charge of the Minnesota PWA office on a $17,000,000 sanitary project, he opened a general consulting office in 1938. As colonel, he is now Assistant to the District Engr., Jacksonville, Fla.

Burt Harmon's experience falls into various periods: 1903–1914, water works and hydroelectric construction; 1913–1923 (with 2 years out for war service), flood control design and construction for Los Angeles County and U.S. Engr. Dept.; since 1923 hydraulic engr., Long Beach Water Dept.

Arthur F. Pillsbury (Stanford, '28, Engineer, '30) has been with the Irrigation Div., U. of Calif., College of Agriculture since 1932. His principal work has been on investigations of irrigation water supply and quality, soil-plant-water relationships, farm irrigation systems, and factors affecting infiltration capacities of soils.

Ralph Lowry (State College of Wash., B.S., '13; Masters in C.E., '17) entered the Bur. of Reclamation in 1914 and has been with it ever since. Assignments have included Yakima Project, McKay Dam in Oregon, Gibson Dam in Montana, and Lake Cle Elum Dam in Washington. On Boulder Dam, he was field engineer, 1930–1934, and construction engineer and director of power, 1935–1938. Since 1938 he has been construction engineer on Shasta Dam.

E. P. Goodrich (U. of Mich., B.S. in C.E., '98) had early service in the Navy during the reconstruction of the New York Navy Yard. Later, as chief engineer of the Bush Terminal Co. and Affiliates, he had charge of the design and construction of the Bush Terminal on New York Bay. After war work he returned to private practice, consulting on design of harbors and on city planning, and acting as consultant to the Regional Plan of New York and environs.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Preparedness and the Engineer

Based on an Address Before the Last Annual Meeting of the Engineers' Council for Professional Development

By Sidney D. Kirkpatrick

Editor, *Chemical & Metallurgical Engineering*, McGraw-Hill Publishing Company, New York, N.Y.

During World War I, Woodrow Wilson said that the sinews of war were men, money, and munitions. They still are, but perhaps we now rate them in a different order of importance. Poland's failure first proved to the world the inability of mere man-power to resist a highly mechanized and motorized army in action.

Other Ingredients, Too.~Mere money, which we have lately seen appropriated in the billions in this country, cannot buy preparedness in the open market. We cannot protect our shores with airplanes or destroyers "on order." So we must add several more words to President Wilson's interesting alliteration, before we get to the vital subject of munitions. There must be (1) a mobilization of manufacturing industries; there must be (2) materials, metals, and minerals; it takes (3) the methods of modern management to make all these work effectively; and topping all this is (4) morale (which a great soldier has aptly defined as "civilian courage"), the motive power behind any great endeavor such as the one we face today.

Gradually during the past year, we have all come to the realization that national defense is, temporarily we hope, America's No. 1 industry. We are suddenly transplanting or superimposing on our peace-time economy a great 20-billion-dollar industry. This heavy, but necessary burden of non-productive enterprise must be carried by all of us. It bears heaviest, in a certain sense, on the engineer, because munitions manufacture is a highly technical field of industry—one that requires trained judgment and skill as well as resourceful knowledge of science and technology.

Basically an Engineering Job.~Lloyd George in writing of his experiences as Minister of Munitions in the first World War said:

"It soon became evident to clear eyes that the war would be fought and ultimately decided in the work shop and laboratory."

Germany learned that lesson all too well for the good of the rest of the world. For six years her work shops and laboratories have been engaged in a tremendous effort. It is significant, too, that at the beginning her program was delayed for many months because of a shortage of technically trained men and skilled mechanics. Then she started intensive training courses and as far as we can learn, these are still an essential part of the German war machine.

This is something that we must not overlook in this country. And to a large measure it is the responsibility of the leaders in engineering education. Those facilities and services being set up in this country for training artisans and operating employees as well as college men can well become a primary field of activity for many engineers and teachers.

To Each His Own Task.~Today many men in industry also are asking themselves what they can do to help in forwarding our program of national defense. All of us realize that it is more than a duty; it is an opportunity for every American who wants to do something for his country. And again the question is, "What?" It is a problem each man must settle for himself. Here is the way one executive has answered the question:

"What we can do best for the nation as a whole depends on our occupation and on our experience, but one thing of major importance that all business men (and engineers as well) can do, in one way or another, is to help others to learn through training how to do their jobs better."

In our communities and through local sections of our engineering societies, we can help in setting up defense committees to tackle various phases of this problem. First comes the job of recruiting and training for service in industry; next will come the matter of supplies and mobilization of all the other resources that may be necessary as the program advances.

Management a Major Problem.~The number of men with sufficient experience to manage and operate the large munitions plants is distinctly limited. This is one of the reasons why the government was forced to abandon earlier plans for decentralization into a large number of small plants scattered throughout the country. Larger plants will avoid too great dilution of managerial personnel. Yet the hugeness of these plants is a problem in itself.

Not long ago I talked with a chemical executive who is helping to lay out a large government-financed but privately operated shell filling plant. It will employ 15,000 men in five separate assembly lines, which of necessity must be 3,000 ft apart. Almost 200 carloads of raw material will be shipped into this plant each day and 100 carloads of shells, bombs, and fuses will leave it. What my friend is beginning to realize is that this is a much larger problem than his industry has been up against in its various plants, none of which employs more than 200 or 300 men. In such small plants, planning and scheduling can be done at odd moments by the superintendent or the plant engineer. In these great government plants, however, a whole corps of experienced industrial engineers will have to give their full time to such work.

Approaching Shortage of Engineers.~National defense means more than munitions plants. It also means new construction by private capital and increased capacity in existing plants. What the total man-power requirements for all defense activities will amount to is anybody's guess, but many observers believe that it will be only a matter of months until there will be no serious unemployment in this country. We have already seen this happening in the case of technically trained personnel.

The smokeless powder, high-explosives, and ammunition plants to be completed in 1941 alone will require 65,000 to 75,000 workers. It is fair to estimate that at least 10% of these must be engineers and chemists. Chemical control will call for about 4,000 supervisors. And, in addition to these huge requirements, the Army will probably need upward of 2,000 chemically trained inspectors.

When these thousands of engineers for the munitions plants are added to the unknown thousands needed in the airplane factories, the shipyards, tool and machine shops, and other defense plants of private industry, it is evident that we are fast approaching a personnel shortage more serious than any we have ever known in this country.

Further Expansion in Prospect.~Most of those who have studied the need for engineering man-power feel that the pinch will come late this summer. The first six months of 1941 will have seen the construction program completed in most of the munitions plants. As the equipment is installed and the plants go into operation, the big need will be for superintendents, supervisors and foremen, plant engineers and chemists. The engineers with the construction companies will be available for other projects and, from present indications, they will not have long to wait for these to develop.

Several billion dollars have already been appropriated under the Lease-Lend Act, part of which will be spent in another huge chain of munitions plants. Likewise, there are plans under consideration for practically doubling the present preparedness program—in other words, to prepare for a four-million man army rather than the two-million man army now in process of being trained and equipped. This will require tremendous expansion of most of our manufacturing facilities.

Canadian and British Experience.~In talking last fall with a group of editors, Prime Minister MacKenzie King said that the most difficult position he had in his War Cabinet, the portfolio of the Minister of Supplies and Munitions, was held by a civil engineer, C. D. Howe, M. Am. Soc. C.E., who had been born in Maine. The Canadian leader said that the only reason Mr. Howe could carry so many responsibilities was that he had so many deputy ministers under him, but he implied that as an engineer he had both the knowledge and organizing ability to keep all these men busy at once on a tremendous program.

In England, as we know, there is compulsory registration of engineers. The order signed by the Minister of Labor and National Service on July 14, 1940, applies to "any person who is normally engaged in the engineering profession in a consultant, technical or supervisory capacity in design, construction, manufacture, operation or maintenance and who has had a regular professional training in practice and in theory as an engineer in any of the following branches: aeronautical, automobile, chemical, civil, electrical, gas, locomotive, mechanical." In addition, there are classifications for production or staff engineers in positions of responsibility above the rank of foreman and of engineering scientists "who have obtained an honored degree in any university in the British Empire and who are normally engaged in research work in the engineering sciences at any such university or in research or development work in any industry or as a teacher of engineering science."

We have seen the beginning of some of these things in Washington. It is encouraging to find more of this thinking developing in the administration of the Selective Service Act. The "National Roster of Scientific and Specialized Personnel," in which the Society has aided so materially, corresponds on a voluntary basis with the compulsory scheme now in effect in England. Its job is to catalog, by means of questionnaires, the country's entire resources of technical man-power. The National Resources Planning Board had sent out more than 150,000 questionnaires prior to January 1, 1941. The personnel data so collected will be collated and transcribed on special cards, so indexed that these roster lists can make available quickly to the Army or any other governmental agency, the names and addresses of the engineers and scientists in this country who have the desired qualifications in training and experience.

Production, Not Politics.~In the Office of Production Management and in its predecessor, the National Defense Advisory Commission, it is significant that so many of the key jobs are held by engineers. An increasing percentage of the priority program is being administered by technically trained men. They are in positions of responsibility because they think in terms of production rather than of politics.

So, getting back to Woodrow Wilson's "men, money and munitions," I am inclined now to think he was right in putting man-power first in this important trinity. But I would qualify it with this reservation: Today's wars are being fought by men in offices and factories rather than by men in trenches. This means that preparedness is primarily an engineering function—to convert to war use all the advances of science and technology that will make for mass production of the necessary munitions and their effective use, if necessary, in protecting all that we hold dear in these United States of America.

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Investigations for Roofs of U.S. Capitol

After 90 Years Trusses Need Replacement; Temporary Repairs Made

By HERMAN F. DOELEMAN, M. AM. SOC. C.E.
CONSULTING ENGINEER, BALTIMORE, MD.

SOME structures, upon investigation, appear to have so tenuous a basis for existence that they seem in fact to stand up by that type of structural stability popularly known as "force of habit." The roofs over the Senate and House wings of the U.S. Capitol were hardly that bad. Nevertheless, by impairment over a period of many years, they had reached a condition of considerable danger. How the investigation of the situation proceeded and what remedies were planned is told in this instructive paper, delivered before the Structural Division at the Society's 1941 Spring Meeting in Baltimore, Md.

MUCH furore has been created in the daily press by reports of dangerous deficiencies in the roofs over the legislative chambers of the U.S. Capitol in Washington. Some of the anxiety was undoubtedly justified. An account of the necessary investigation and of the measures taken to rectify the trouble is therefore of public as well as engineering interest.

First as to background. Some years ago, David Lynn, Architect of the Capitol, considered it advisable to arrange for an investigation by private and government engineers to ascertain fire hazard conditions and to determine the structural sufficiency of certain parts of the U.S. Capitol Building. As a result the wood construction over the Supreme Court and Senate Library sections; Statuary Hall, or old House of Representatives section; all the central part surrounding the dome; the east portico of the House wing; east and west porticoes of the central portion; and the east portico of the Senate wing, were replaced with modern steel and concrete construction.

As the roof framing over the House and Senate wings, including the roof trusses over the chambers, had been in place over eighty years, it was decided to investigate the condition and structural sufficiency of this work also. Accordingly Thomas W. Marshall, M. Am. Soc. C.E., consulting engineer of Washington, D.C., was commissioned to make the necessary survey and render a report, which was submitted to Mr. Lynn on November 29, 1938. This report indicated that the roof trusses and their bracing over both chambers were seriously deficient in strength as compared with good modern engineering practice, and that the framing over the areas surrounding the chambers, while not dangerous, was of non-fireproof construction and presented a fire hazard. He recommended that the roof over both wings be removed and replaced by new construction of modern fireproof design.

As soon as Mr. Lynn called the attention of the House Subcommittee on Appropriations to this situation, the committee asked to have the Marshall Report checked

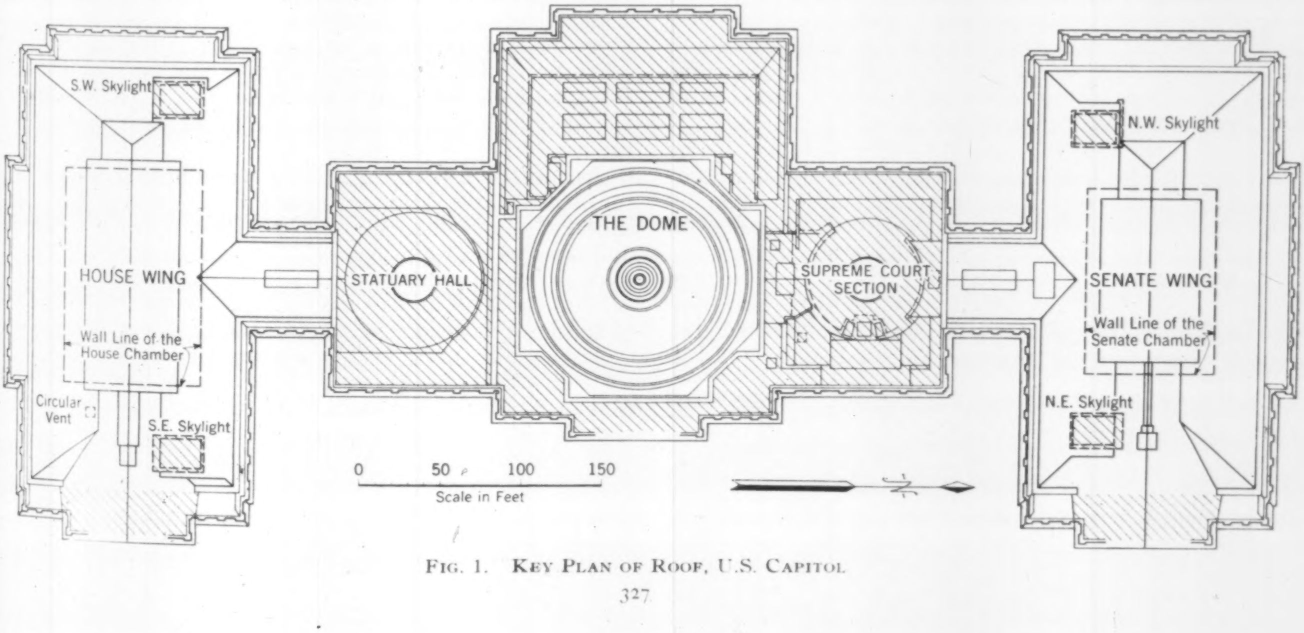


FIG. 1. KEY PLAN OF ROOF, U.S. CAPITOL

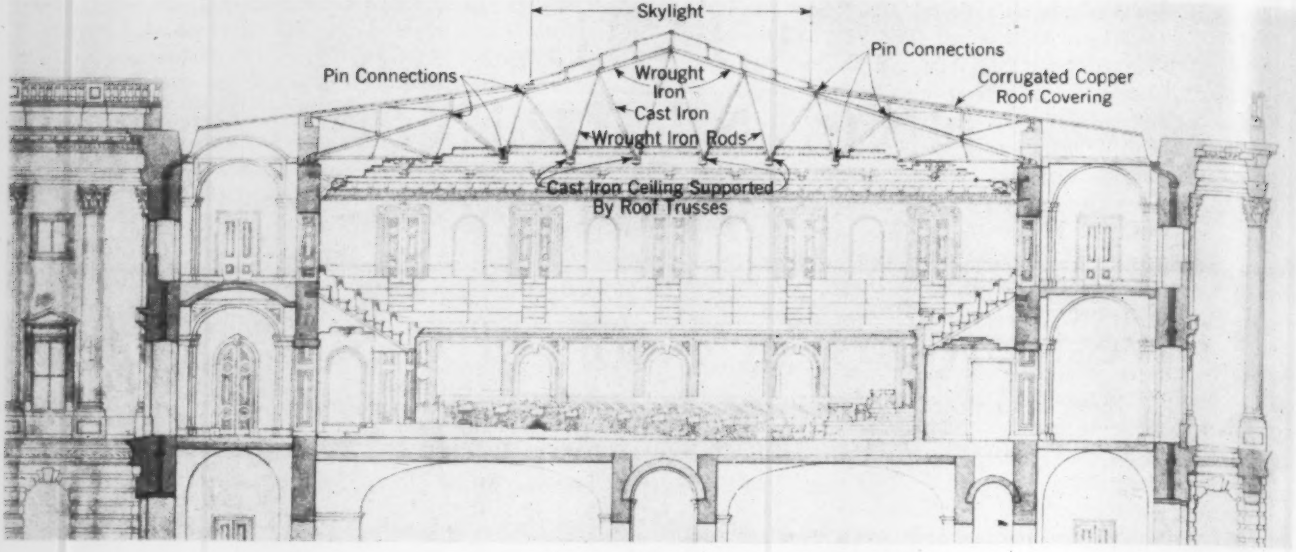


FIG. 2. SECTION SHOWING UPPER PORTION OF HOUSE WING, LOOKING EAST
From Original Drawing

by government engineers. Early in 1939 a report was received signed by William R. Osgood, Assoc. M. Am. Soc. C.E., Materials Engineer, National Bureau of Standards; A. E. Falconer, Structural Engineer, Bureau of Yards and Docks; and C. G. Palmer and P. A. Randall, Architectural Engineers, Procurement Division, Treasury Department. This report concurred in the findings of Mr. Marshall and recommended that the roof trusses be replaced.

In March 1940, before the Subcommittee of the Committee on Appropriations of the Senate, Senator Tydings, chairman, suggested that a report be obtained from still another engineer, this report to be final and to be available in time to include any necessary amount for reconstruction in the then pending deficiency bill, the estimated cost being $585,000. A few weeks later, on May 10, 1940, a Special Joint Committee consisting of Senator Connally and Representative Rabaut designated the writer to review the Marshall Report and make final recommendations. Since the deficiency bill was to be presented shortly and the cost of reconstruction had to be entered in that bill, I was allowed only ten calendar days in which to complete my report.

On May 11, the Congressional Committee also invited F. H. Frankland, M. Am. Soc. C.E., Chief Engineer of the American Institute of Steel Construction, to render a report. His report as well as mine substantiated those previously rendered by other engineers.

In Fig. 1, showing the capitol roof in plan, the shaded areas indicate the parts reconstructed previously. The central or dome section has been the subject of many newspaper articles, which have questioned the safety of its construction. Even in 1940, when orders were issued for a final report on the chamber roofs, such articles appeared. Now the construction of the dome had been thoroughly investigated, and the work pronounced safe by most competent engineers in August 1933.

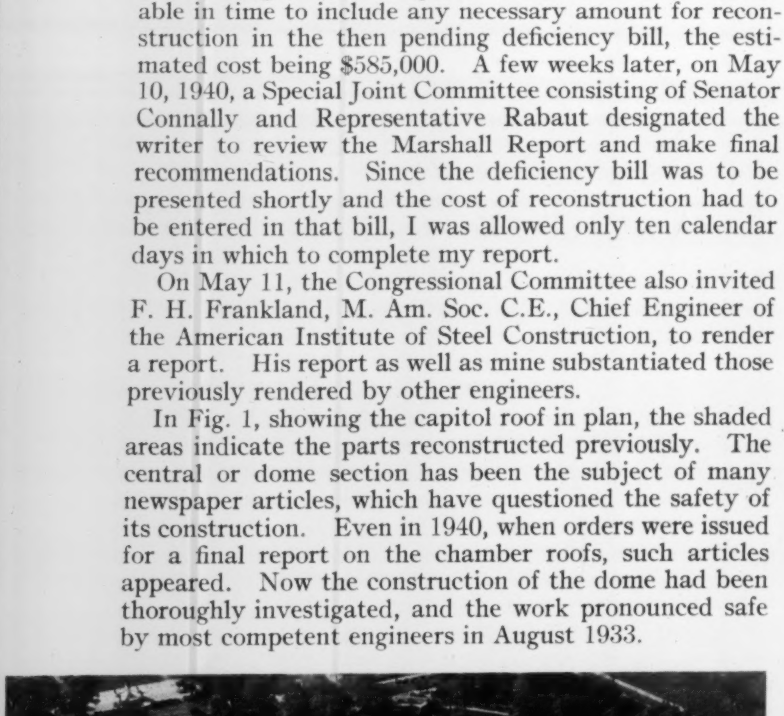
The two wings are similar but not identical. The Senate Chamber is the smaller, being 82 ft wide and 114 ft long, while the House Chamber is 96 by 140 ft. The framing over both chambers (Fig. 2) consists of trusses spanning the short way, spaced about 9 ft 8 in. apart. They rest on very heavy walls and have roller bearings at one end. The central portion over each chamber is covered by a large skylight; the outer portion by corrugated copper sheets, supported on small purlins made of angles on which wood blocks are screwed. The bottoms of these purlins carry a plaster ceiling, applied to wood laths. This plaster, a very thin coat, was found to be dropping off in many places. The roof area around the chamber walls is also covered by the same type of construction, the purlins being carried on brick walls, which according to Mr. Marshall are located without respect to the supporting construction below.

Ceilings of both chambers are constructed of light iron castings, forming the decorated ceiling seen from the floor below. These castings carry the ceiling lights and are hung from the trusses above, usually from bolts passing through flat bars. The bars in turn bear on the eyebars which form the bottom chords of the truss, the hangers straddling the eyebars. The general arrangement of the trusses is shown in Fig. 2 for the House Chamber. The Senate roof truss is similar except that the span is shorter and has 8 instead of 10 panels along the top chord. Otherwise general details of both trusses are similar.

As for the top chord, it is a wrought-iron bulb-iron (or deck beam) 5 in. wide and 7 in. deep. It has a splice at about the middle of the length of each rafter and always near the center of a panel, consisting of a plate on each side, bolted with three heavy bolts on both sides of the joint and a plate on top, secured on each side of the joint with four small rivets.

At the peak these bulb irons fitted into a socket in a casting, which also engaged the pin connecting the tension members at that joint. At the heel a similar joint occurred, distributing the stress into the shoe and the pin connecting the bottom-chord members.

The bottom chord consisted of two eyebars throughout, 4 by 1 in. in size for the central panels, increasing to 4 by $1^1/_4$ in. for the two end panels. These bars were forged in one piece and enlarged at the panel points to



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AIR VIEW OF U.S. CAPITOL, LOOKING NORTHWEST UP PENNSYLVANIA AVENUE receive the pins. Similarly, the tension webbing consisted of pairs of 2 by $^1/_2$-in. eyebars. All compression members were cast iron in the shape of a cross with yokes to engage the top chord and flattened ends at the bottom, all drilled for the pins. Castings are dated 1854.

As may be inferred, all connections were pins. The top chords were provided with forgings at the panel points, fitting the bulb-iron shape. The skylight was supported by short angle-iron posts resting on the top chord, not always located at the panel points. In the panels at each side of the peak, the loads carried by the posts created no small increase in unit stress.

A bulb angle of the same section as the top chord acted as a continuous strut along the peak. Further, there were two continuous ties at the bottom, one on each side of center, consisting of small eye-beams, with a cross-bracing of rods to the panel points of the top chord on each side of the peak in all bays; but there was no strut in the plane of the top chord to take up the stress in these cross-bracing rods.

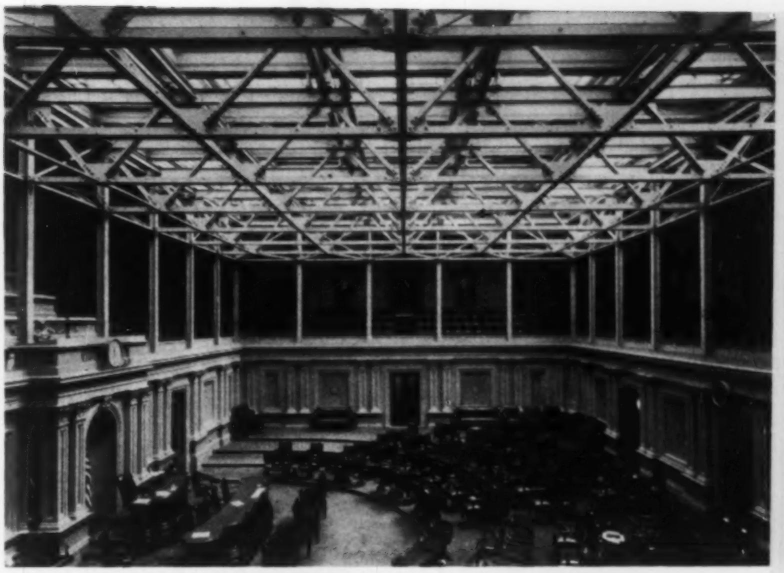
The top-chord bracing, if it be deserving of the name of bracing, was most unique. The only stiff member was the peak strut; the remainder was a network of $^5/_8$-in. rods over the whole plane of the rafters. These rods connected by loops to forgings—a flat portion with a pinhole to engage a pin, and with rings attached for the loops of the rods. Any stress on the rod pulled directly on the head of the pin. These rods were connected midway between adjoining trusses to a ring made of flat iron, through which passed the threaded rod ends, with a nut for adjustment. At the end walls iron anchors were embedded in the brickwork and the bracing rods of the end bays connected to them.

For the ceiling cast iron was used, not heavy marble, as repeatedly stated in some newspapers. The ornament is in bold relief, large cornices around the four walls, a wide belt higher up, and then the main ceiling divided in large panels with ornamental glass covers about a foot higher up.

In its central portion, the ceiling is hung from the eyebars but in the raised belt between the last two trusses supports were introduced made of two square bars, one straight, and above it, one bent. These bars were in a vertical plane, riveted together at the ends. By means of a wedged tie at the center they formed a sort of shallow king-post truss, over 9 ft long and only about 6 in. high, from which the cast-iron ceiling was hung on threaded rod hangers. The ends of these trussed bars rested on the heads of the eyebars—a flat surface on a rounded one—and there was no fastening of any kind. As will be shown later, the arrangement left much to be desired. The cornice along all four walls was supported on iron brackets, secured to the wall.

A careful inspection showed no indication of wear or rust. The shapes, both cast iron and wrought iron, were properly made with one defect noticeable—a slight gouging out of the top flange of a bulb iron. The alinement, however, presented a different picture. In the first place, to the eye the pins appeared to be bent, but there was no way of verifying the actual deviation by measurement.

The eyebars of the web members of some trusses did not perform their functions at times, one being slack, the other extremely taut. This was especially noticeable in the last truss near the end walls. It was at those trusses that the trussed bar supports had a very short bearing, often less than $^1/_4$ in. and one had even slipped sidewise off the eyebar head and was resting on the bar itself. Quite likely the bottom chord of the truss, with a load resting on one side only, had moved.



TEMPORARY STEEL TRUSSES INSTALLED UNDER CEILING
This Is Senate Chamber; House Chamber Is Similar Although Room Is Larger

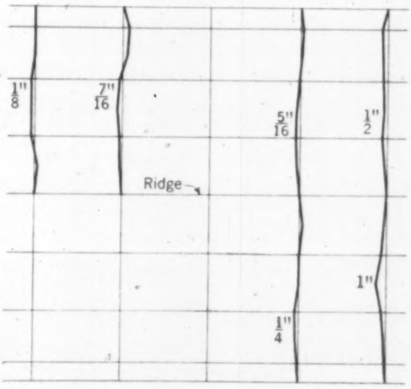


FIG. 3. PLAN VIEW SHOWING LATERAL DEFLECTIONS OF TRUSSES, UPPER CHORDS
Some Measurements Taken on the Senate Wing

Deflections of the top chords in the plane of the rafters were noticeable to the eye, so measurements were taken (Fig. 3)—a difficult job on account of the many obstructions in the form of pipes and air-conditioning ducts. All in all, 12 lines were established and the deviations of 72 panel points were noted. Of these, only 12 points were in their proper position; all others showed serious variations from the straight line, especially alarming where they occurred at the point of splice. One of these joints is 1 in. out of its proper position (Fig. 3), being $^1/_2$ in. out of the way in a length of 158 in.

Computations for unit loadings showed that the top chord supported 47 lb per sq ft on the plastered section and 45 lb per sq ft on the skylight portion; of these, 30 lb was live loading due to snow and wind. On the bottom chord there was 21 lb per sq ft, half of which was attributable to the cast-iron ceiling. No allowance was made for live load on the bottom chord, although plank walks through the center give access to the whole area and workmen often enter for repairs and adjustments to wiring, pipes, and ducts; but it was felt that such load could always be kept at a minimum. The main stresses in the trusses are shown in Fig. 4.

When these trusses were designed about 87 years ago, the knowledge of proper analysis and stress was limited. Great liberty was taken with ratios of slenderness. Bending moments on pins were evidently not taken into account by the designer.

In the analysis of the design of the top chord, the value of allowable stress on the wrought-iron sections was assumed to be 80% of that of steel, based on the widely used formula $\left(\dfrac{18,000}{1+\dfrac{l^2}{18,000\,r^2}}\right)$. The properties of the bulb iron were: area = 9.20 sq in.; I = 61; S (section modulus) = 16; r_x = 0.9 in.; and r_y = 2.6 in.

As to the Senate roof truss, it should be noted, Table I (*a*), that in panels 3-4 and 4-5 the l/r was 177, and that overstress occurred with a high ratio of slenderness. As to panel 3-4; this includes the splice, and the sketch recording deflections (Fig. 3) distinctly shows the weakness of this section. Obviously, a ratio of 177 would not be used by any modern designer for a main member such as a top chord of a truss, regardless of the stress.

The bottom chord eyebars showed stresses ranging from 5,050 to 7,900 lb per sq in. and therefore are amply safe, while the eyebars acting as tension web members develop a stress of 6,750 lb per sq in. Their strength, also, cannot be questioned. As to the cast-iron struts used as compression members, the maximum stress (with $l/r = 148$) is only 1,250 lb per sq in. and these members therefore cannot cause any concern.

Using the same basis of analysis, the stresses developed in the top chord of House trusses are as shown in Table I (*b*). Whereas the l/r ratio, with a maximum of 136, is only slightly excessive, the overstress is apparent in all members. The panel spliced in midlength (member 3-4), with an overstress of 30%, showed a maximum displacement of $^1/_2$ in. Only five such points were checked on account of lack of time and accessibility; the maximum movement at any panel point investigated was $^5/_8$ in.

Bottom-chord eyebar stresses ranged from 6,900 to 9,900 lb per sq in.; eyebars of webbing developed a maximum stress of 8,500 lb per sq in., so are amply safe. The cast-iron compression members, with a maximum l/r of 90, are stressed only to 1,560 lb per sq in.

Investigations of pins of both trusses showed that, whereas they were of ample size as to shear and bearing, the theoretical bending stresses ran as high as 78,000 lb per sq in. Obviously, bending of pins and readjustment of bearing must have occurred. For the Senate truss, 13 pins out of 17, and for the House truss, 13 out of 21, were overstressed, the greatest stress occurring in the top-chord pins. It is doubtful, moreover, if the connections of packing plates to the webs of the bulb irons were fully developed.

In the report to the Joint Congressional Committee it was stated that in my opinion the roofs as constructed were unsafe, the main defects being the unbraced condition of the top chord, the excessive ratio of slenderness of this chord, and the strain on the pins. It was further stated that reinforcing or reconstruction did not seem feasible, and it was recommended that present construction be replaced with a roof of modern design; also that there be no delay in strutting the top chord at panel points and all points of splice—this work to be done before reconstruction was attempted, so as to prevent further movement in the plane of the rafters.

Both my investigation and Mr. Frankland's sustained the Marshall report of 1938. Taking prompt action, Congress authorized reconstruction. The Architect of the Capitol at once proceeded to brace the top chord with wood struts, bolted to the steelwork, and also provided new supports in place of the trussed bars which had shown signs of movement.

Reconstruction was delayed because the usual summer recess of Congress was abandoned in 1940. Mr. Lynn therefore proposed that a temporary framework be erected to support the ceiling, thereby reducing the load on the truss and making the structure temporarily safe. These supports were placed in a minimum of time, the chambers being vacated November 22, 1940, and reoccupied January 3, 1941.

In addition the temporary structure will act as a falsework for the final permanent framing, and members have been provided to support the temporary roofs which will protect the chambers during reconstruction. This work, described in *Engineering News-Record* for January 23, 1941, was designed by Marshall and Gongwer, Washington, D.C.

Plans for reconstruction are now proceeding under the supervision of the Architect of the Capitol; the engineering work is being done by Marshall and Gongwer, with the writer as consultant to the Office of the Architect. It should be recorded that when I was asked to review the calculations of Mr. Marshall I preferred to make an independent study so that previous findings would not influence my judgment. The results I obtained checked so closely with those of the first investigator that a check of calculations was unnecessary.

TABLE I. STRESS CONDITIONS IN ROOF-TRUSS MEMBERS

BETWEEN PANEL POINTS	LOAD IN KIPS	l	r	l/r	STRESS IN LB PER SQ IN. Allowable	Actual	Excess	OVER STRESS IN %
				(*a*) *For Senate Wing* (*Fig. 4 a*)				
1-2	79	72	0.9	80	10,600	8,600	...	..
2-3	68	141	0.9	156	6,120	7,400	1,280	21
3-4	57.5	159	0.9	177	5,250	6,250	1,000	19
4-5	47.5	159	0.9	177	5,250	10,950*	5,700	108
				(*b*) *For House Wing* (*Fig. 4 b*)				
1-2	105	114	0.9	127	7,600	11,500	3,900	51
2-3	95	122	0.9	136	7,100	10,350	3,250	46
3-4	85	122	0.9	136	7,100	9,250	2,150	30
4-5	74	122	0.9	136	7,100	8,050	950	14
5-6	65	122	0.9	136	7,100	11,000†	3,900	55

* Direct stress 5,150 lb; bending 5,800 lb.
† Direct stress 7,100 lb; bending 3,900 lb.

Acknowledgment is hereby made to David Lynn, Architect of the Capitol, and H. D. Rouzer, Assistant Architect, for the information aiding the investigation; to Thomas W. Marshall and James M. Gongwer, Members Am. Soc. C.E., for their helpful assistance throughout; to F. H. Frankland, M. Am. Soc. C.E., for the many suggestions made during the physical inspection; and to H. L. Crandall, Assoc. M. Am. Soc. C.E., who assisted the writer by checking the calculations.

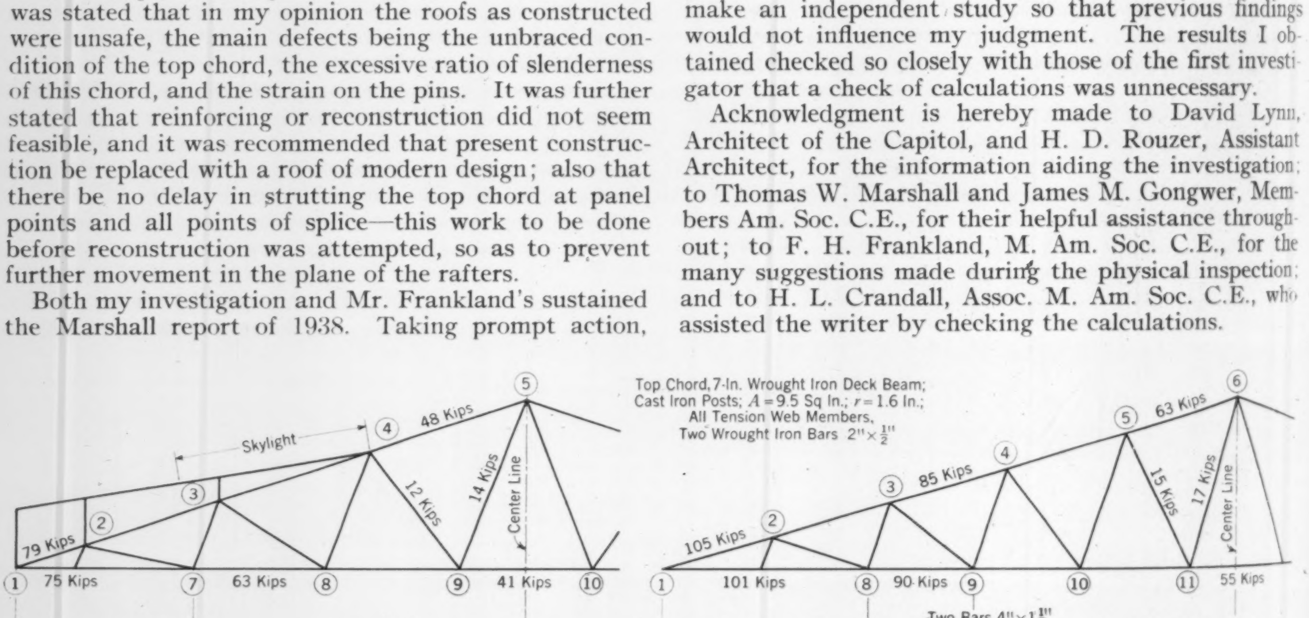


FIG. 4. HALF ELEVATIONS OF ROOF TRUSSES, WITH STRESSES
(*a*) Senate Wing, (*b*) House Wing

Civil Engineering and the Wage and Hour Law

By Philip B. Fleming

Brigadier General, U.S. Army; Administrator, Wage and Hour Division, U.S. Department of Labor, Washington, D.C.

IN general, civil engineers do not consider themselves as coming within the purview of the Wage and Hour Law. As regards most of the work this is probably correct. However, many engineers, as General Fleming here explains, are engaged in work that brings them under this law. And draftsmen and office staffs of engineering firms are usually covered by the law, he says. This summary of the engineer's relation to important government regulations, including the definition of what the Wage and Hour Division considers the "professional" engineering employee to be, is therefore of immediate importance—especially because it comes direct from the Administrator, himself a military engineer.

ENGINEERS, civil and military, are the men in whose conversation I find greatest pleasure, being a true professional in this respect at least. But engineers have been rare among my callers at the office in the U.S. Department of Labor, which I have occupied since the President detailed me as Administrator of the Wage and Hour Division.

Civil engineering is not greatly affected by this Wage and Hour Law. The law requires payment of at least 30 cents an hour and time-and-a-half the regular rate after 40 hours a week, for employees engaged in interstate commerce or in the production of goods for interstate commerce.

The civil engineer is usually engaged in construction. The Wage and Hour Division takes the position that employees engaged in the original construction of buildings are not engaged in commerce or in the production of goods for commerce, and therefore do not fall within the coverage of the act.

However, the law applies to the employees of many engineering firms; and there are civil engineers whose work brings them under its provisions. Many of these engineers are exempt as professional—some under the original definition of professional, promulgated before the act went into effect on October 24, 1938; and many more under my redefinition of the term which went into effect on October 24, 1940.

In the summer of 1940, we held extensive hearings and invited suggestions on defining this exemption. Telephone companies and some oil companies who employ engineers sent representatives. They described the work of their engineers and discussed their status under our definition of "professional." None of the employing engineers sent representatives, which would indicate to me that they did not then, and some of them may not yet, understand that many of their employees are covered. That is why I welcome the invitation of the American Society of Civil Engineers to discuss, in its publication, the effect of this law on the profession.

Many employing engineering firms operate on an interstate basis. We believe that the clerical help of such firms will be held by the courts to be subject to the act. I would suggest that engineering firms resolve their doubts by complying with the 40-hour week in the administration of their home offices. That is, they should keep accurate records of the hours worked by all employees and they should pay time-and-a-half the regular rate to non-exempt employees when unusual situations cause them to be worked beyond the conventional office work week, which today is 40 hours.

In the statute, as passed by Congress, the phrase "engaged . . . in the production of goods," is considerably broadened by the definition of "goods." This definition reads, " 'Goods' means goods (including ships and marine equipment), wares, products, commodities, merchandise, or articles or subjects of commerce of any character, or any part or ingredient thereof. . . ." To quote the Division's Interpretative Bulletin No. 5, issued in December, 1938, "It seems clear that the term 'goods' includes publications, pamphlets, or any other written material." It also seems clear that such a broad definition of "goods" includes blueprints prepared in the home office for use in other states. Draftsmen engaged in making drawings for these blueprints are covered.

The engineer in the field engaged on construction work is covered if he is engaged in the maintenance, repair, or reconstruction of an essential instrumentality of interstate commerce or of buildings or machinery used to produce goods for interstate commerce. Thus, some construction work is held to be in interstate commerce. An irregular boundary wall formed by court decisions leaves the engineer, schooled in direction and simplification, a bit impatient with the construction of his legal brethren. The U.S. Supreme Court has held in a railroad case, for example, that employees engaged in the drilling of a tunnel are not in interstate commerce because no trains have yet run through that tunnel. But the repairing of that tunnel, after it has become a link in the interstate roadway of the railroad, is work in interstate commerce.

Engineers are frequently employed in the maintenance, repair, or reconstruction of essential instrumentalities of interstate commerce. If their employment is covered and they are not exempt as "professional," they must be paid time-and-a-half their regular rate after 40 hours. Other engineers are employed in the production of goods for interstate commerce, such as engineers employed by oil producers and mining companies. Others are engaged in interstate commerce, such as engineers employed by transportation and communication companies. These also must be paid time-and-a-half unless exempt as "professional."

There are other labor laws with which the engineering profession is generally familiar. These are the "eight-hour law" and the so-called "Davis-Bacon" law. These laws are not administered by me, but a brief explanation of them might be proper. The "eight-hour law" provides that "laborers and mechanics" on "public works" of the United States shall not work in excess of eight hours a day unless they are paid time-and-a-half their basic rate of pay for the excess hours. Civil engineers are not "laborers and mechanics" but engineering firms often have such employees. The "Davis-Bacon" Act is also applicable to "laborers and mechanics" and provides that construction contractors doing work for the United States shall pay their laborers and mechanics not less than the rate of wages as determined by the Secretary of Labor to be the prevailing wages in the particular community where the work is being performed.

The Walsh-Healey Public Contracts Act prescribes labor standards in the execution of any contract made by the United States "for the manufacture or furnishing of materials, supplies, articles, or equipment in any amount exceeding $10,000." All employees (except office, supervisory, custodial, and maintenance employees) who, after the date of the award, are engaged in any operation preparatory or necessary to, or in the performance of, the Government contract are subject to the Act. This paragraph in the revised Walsh-Healey rulings and interpretations issued by the Secretary of Labor brings some engineers within its coverage:

"The following employees have been construed to be employees engaged in or connected with the Government contract: . . .

"Draftsmen engaged in the preparation of drawings required to be supplied to the Government, or prepared subsequent to the date of award for use by the manufacturer in producing the materials, supplies, articles, or equipment to be supplied to the Government. This rule does not apply to draftsmen engaged in a supervisory capacity."

This law differs from the Wage and Hour Law in the matter of overtime by requiring that time and one-half be paid for each hour over eight a day. Overtime does not start under the Wage and Hour Law until 40 hours have been worked in one week.

Defining the "professional" employee exempt from the Wage and Hour Law was not easy. The definition was designed to include some journalists, actors, photographers, as well as those professions held by the courts to be "learned" professions, i.e., law and medicine.

On my first assignment as an engineer I was sent to the waterfront to report to the head engineer. I came upon a workman leaning against the top of a piling.

"Where's the engineer?" I asked him.

"Do you mean an ordinary engineer or one of these here microscope guys?" he asked me.

Evidently "one of these here microscope guys" was his definition of a professional engineer. Here is the definition we arrived at after considerable study:

"The term 'employee employed in a bona fide . . . professional . . . capacity' in section 13(*a*)(1) of the act shall mean any employee who is—

"(*A*) engaged in work—

(1) predominantly intellectual and varied in character as opposed to routine mental, manual, mechanical, or physical work, and

(2) requiring the consistent exercise of discretion and judgment in its performance, and

(3) of such a character that the output produced or the result accomplished cannot be standardized in relation to a given period of time, and

(4) whose hours of work of the same nature as that performed by non-exempt employees do not exceed 20 per cent of the hours worked in the work week by the non-exempt employees; provided that where such non-professional work is an essential part of and necessarily incident to work of a professional nature, such essential and incidental work shall not be counted as non-exempt work; and

(5) (*a*) requiring knowledge of an advanced type in a field of science or learning customarily acquired by a prolonged course of specialized intellectual instruction and study, as distinguished from a general academic education and from an apprenticeship, and from training in the performance of routine mental, manual, or physical processes; or

(*b*) predominantly original and creative in character in a recognized field of artistic endeavor as opposed to work which can be produced by a person endowed with general manual or intellectual ability and training, and the result of which depends primarily on the invention, imagination, or talent of the employee, and

"(*B*) compensated for his services on a salary or fee basis at a rate of not less than $200 per month (exclusive of board, lodging, or other facilities); provided that this subsection (*B*) shall not apply in the case of an employee who is the holder of a valid license or certificate permitting the practice of law or medicine or any of their branches and who is actually engaged in the practice thereof."

It will be seen that the salary requirement of $200 a month is but one of several tests to be applied to the employee designated on the payroll records as a "professional" engineer.

I think the application of this definition to engineers is fairly simple. Any engineer who is worth his salt should be able to determine whether the work of his employee is "predominantly intellectual and varied in character as opposed to routine mental, manual, mechanical, or physical work."

The reception of this definition in the profession as a whole was favorable. Several engineering societies have endorsed the definition. Some writers in the engineering journals have viewed as "calamitous" this designation by the Administrator of the Wage and Hour Division of young engineers getting less than $200 a month as non-"professional."

My idea is that the only effect the Administrator of the Wage and Hour Division can have on young engineers by terming them "professional" or non-"professional" will be found in their pay envelopes. If they are professional in the true sense of the word, they will soon be qualifying under the definition. If they are not, they will either be doing routine work on the drawing boards, or more likely, will be selling insurance and real estate.

Courtesy, U.S. Steel Corp.

FERN RIDGE SPILLWAY UNDER CONSTRUCTION IN JANUARY 1941

Oregon's Willamette Valley Project

Present Construction of Three Dams and Eventual Development of Other Structures Will Benefit Flood Control, Navigation, Power, Agriculture, and Migratory Fish Life

By C. R. MOORE

LIEUTENANT COLONEL, CORPS OF ENGINEERS; DISTRICT ENGINEER, PORTLAND DISTRICT, PORTLAND, ORE.

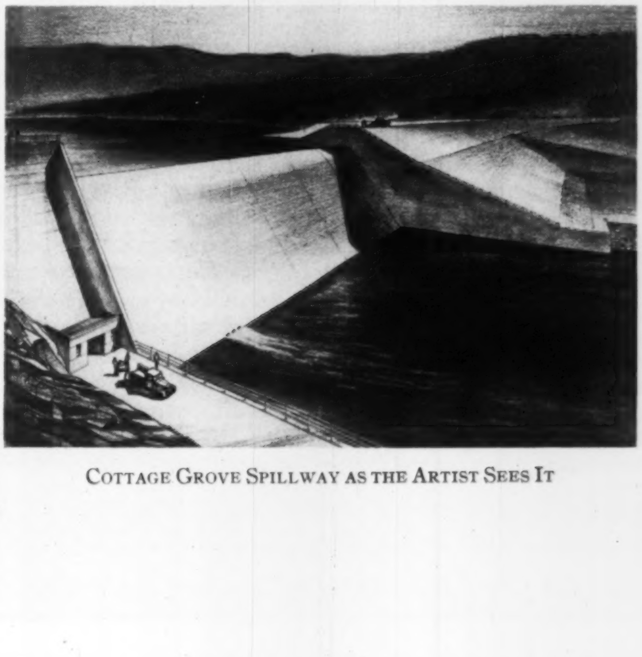
THE bank-full stage is an annual occurrence on the Willamette River. Floods are nearly as frequent. Proposed dams are intended to check these floods with storage regulation and, ultimately, to provide power for industry and water for irrigation during the two or three arid summer months. Colonel Moore points out that if defense industrial needs require, the ultimate power contribution from the basin may be as much as 413,000 kw. This paper originated in a talk given by the author before the Tacoma Section of the Society.

SOONER or later the effects of the Army Engineers' recently inaugurated multi-purpose project for the Willamette River valley will be felt throughout Oregon and, in a larger sense, throughout the United States. The project, adopted by Congress on June 28, 1938, was conceived as a flood control, navigation, power, and irrigation scheme, but its military significance and full economic importance are at present receiving more and more public attention.

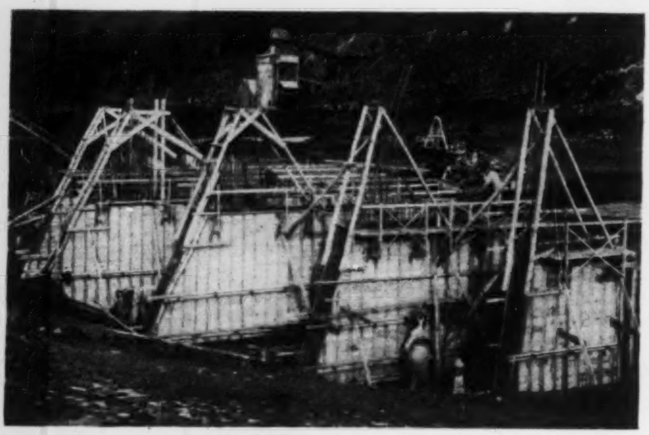
To a great extent the history of the Willamette Valley is the history of Oregon. Early settlers arriving after the Lewis and Clark Expedition of 1806 were hunters and trappers uninterested in agriculture. Later, former French Canadian employees of the Hudson's Bay Company established farms in the vicinity of Champoeg about 27 miles upstream and south of Portland. Within ten years the stream of immigrants from the Middle West and the East commenced to flow into this garden spot of the western coast land. These people were not adventurers lured by the thought of gold and quick riches—they were patriotic farmers concerned with establishing home sites, developing the natural resources, and saving the Oregon country for the United States. As an indication of the character of the pioneers in Oregon, it is of passing interest that in 1849 Abraham Lincoln was asked to become territorial governor. His refusal, reputedly because of Mrs. Lincoln's objections to backwoods hardships, made him available later for the presidency of the United States. By the time he assumed office as President, Oregon was no longer backwoods but had increased her population to 52,000 persons, most of whom lived in the Willamette Valley.

Development of the valley was retarded by the havoc of the great flood of 1861. However, in spite of this setback and the recurrence of later floods of lesser magnitude, the Willamette Basin has become one of the rich agricultural and industrial areas of the United States. Situated in northwestern Oregon (Fig. 1), it comprises 11,200 sq miles of drainage area and is nearly the size of the State of Maryland. Its shape is generally rectangular —150 miles long and 75 miles wide. On its outer fringe the highest mountains in Oregon are found. These encompassing heights on the west, south, and east reach elevations of 3,000, 5,000, and 11,000 ft above sea level.

Few regions of similar size can boast of such diversity of agriculture, such varied topography, and such majestic scenery. Douglas firs (nourished by an annual rainfall of as much as 100 in.) cover the slopes of the mountains. In contrast, the 3,500 sq miles of relatively flat valley floor is dotted by small farms. The mild climate, long growing season, and 40 in. of rainfall per year make agriculture a major industry. Some of the finest fruits in the world—apples, pears, peaches, cherries, and berries, to mention but a few of the products—are



COTTAGE GROVE SPILLWAY AS THE ARTIST SEES IT



FORMS PLACED FOR COUNTERFORT ABUTMENT WALLS 100 FT HIGH—COTTAGE GROVE DAM

grown in the Willamette Valley. The raising of livestock, principally hogs, dairy cattle, and turkeys, also flourishes in the valley. Gently rolling alluvial land, extending from above Eugene to the vicinity of Oregon City, lies at elevations below 600 ft.

If the mean annual precipitation were fairly evenly distributed throughout the year, it would be sufficient to sustain all forms of agriculture. However, it is not so distributed—the rainfall during the summer months is very light, and droughts of from 30 to 60 days are not unusual during this period. These dry periods are often destructive to crops. Simultaneously, very low stages occur along the navigable portions of the Willamette River and prevent year-round navigation on much of the channel. In September of 1940 a $3^1/_2$-ft depth of channel was obtained at Salem only by strenuous dredging and by restricting the width of the channel. In contrast to this summer scarcity is the heavy winter precipitation with its constant threat of destructive high water.

FREQUENT FLOOD DAMAGE IN THE VALLEY

During the fall, winter, and spring of practically every year the discharge of the Willamette River and its tributaries reaches its bank-full capacity. Sometimes it spreads over the valley floor with a resultant disruption of communication, blocking of important strategic highways, stoppage of the production of goods necessary for national defense, and damage and danger to the lives of the residents.

A flood nearly equal to the record flood of 1861 occurred in 1890. A recurrence of the 1861 stage would now inundate to a greater or less degree 7,000 farm units, including 3,000 farm, village, and suburban homes and stores. In addition, it would partially inundate some 18 cities and towns. The communities of Cottage Grove, Junction City, Harrisburg, and West Salem, which produce plywood, finished lumber, and other manufactured articles, would be almost entirely submerged by from 8 to 13 ft of water, should the 1861 flood stage again be reached.

The first improvement of the Willamette River by the Army Engineers was concerned with navigation. This work, begun in 1871, consisted of the removal of snags, boulders, and over-hanging trees, the construction of training walls, and the scraping of shoaling gravel bars to afford continuous passage for light-draft vessels between Portland and Eugene. A canal and locks around Willamette Falls, 13 miles south of Portland, were completed by private interests in 1873.

During the period 1871 to 1937 the Willamette River and its basin were the subject of many investigations and reports. A comprehensive plan of development of the stream and its tributaries is presented in the popularly designated "308 Report" on the Willamette River. Studies were made of possible development of the water resources of the basin, with particular reference to the benefits that might accrue from the construction of hydroelectric power plants. It was not until the enunciation of federal policy in the Flood Control Act approved June 22, 1936, that the Corps of Engineers was authorized to study designated rivers with a view to construction of flood control works.

As a consequence of this act, a report on the Willamette River and its tributaries was submitted to the Chief of Engineers on April 17, 1937. The report recommended modification of the existing project for the Willamette River to provide for: (1) reconstruction of the locks passing navigation around Willamette Falls at Oregon City; (2) construction of seven reservoirs for regulation of stream flow in the interest of flood control, navigation, power development, irrigation, and stream purification; and (3) improvement of the navigable channel of the Willamette River between Oregon City and Albany.

These improvements and an expenditure of $11,300,000 were authorized by Congress, in June 1938, but appropriations made as of June 30, 1940, totaled only $7,454,000. The authorization is sufficient to complete the construction of three dams—Fern Ridge Dam on the Long Tom River, Cottage Grove Dam on the Coast Fork of the Willamette River, and Dorena Dam on the Row River. Actual reconstruction of the Willamette Falls locks and construction of the Detroit, Quartz Creek, Lookout Point, and Sweet Home dams is contingent upon authorization and appropriation of funds by Congress. However, detailed foundation investigations and design studies are in progress. The initial plan for development provides for increasing the height of dams at Lookout Point, Quartz Creek, and Detroit to provide heads and additional storage for further power development. At present it does not include the construction of hydroelectric plants. The cost of the entire project as estimated on January 1, 1941, including flowage, design, structures, navigation improvement, and fish facilities, is $68,616,730.

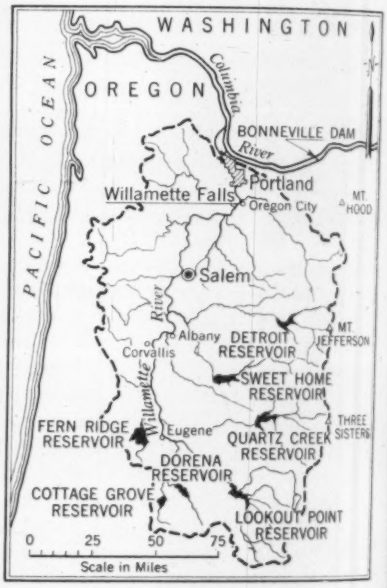
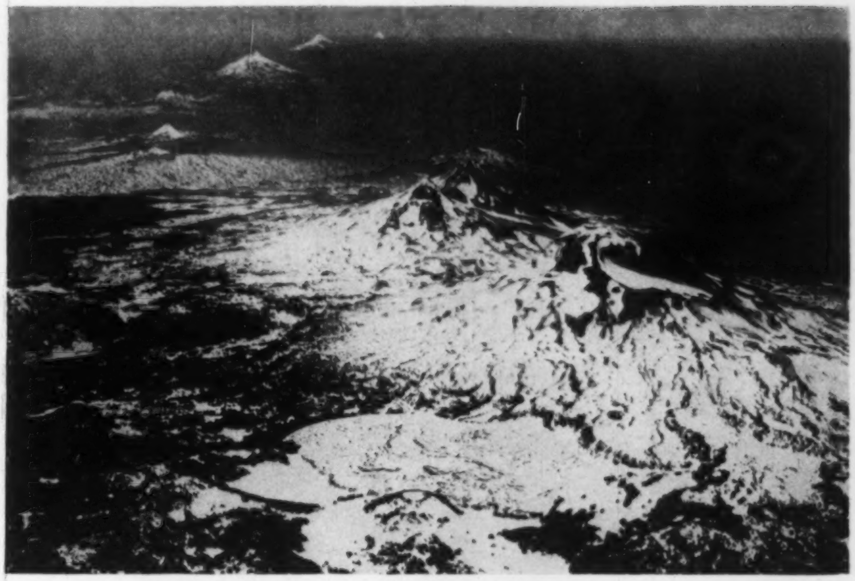


FIG. 1. THE WILLAMETTE RIVER BASIN

The design of the several dams, locks, and incidental works follows conventional procedure. For structural steel 18,000 lb per sq in. was allowed in tension, and compression and shear values were used in accordance with the 1934 revision of the American Institute of Steel Construction specifications and the Navy Department standards for structural steel design. Flat steel plates subject to bending were designed on the basis of Bach's recommended values of moment coefficients. Curved flexural members were analyzed as straight beams and a correction factor applied to obtain the extreme fiber stress. These correction factors were based upon the work of Wilson and Quereau recorded in *Advanced Mechanics of Materials* by Seely. Timoshenko's *Strength of Materials* was also found a fruitful source of information on indeterminate stresses involving the theory of elasticity.

Reinforced concrete design generally follows the provisions of the 1940 Joint Committee code with unit design stresses limited to 18,000 lb per sq in. for steel and 1,000 lb per sq in. for concrete. In the analysis of rigid frames the moment distribution method was applied. For high counterfort retaining walls, the concept of dual systems of beams in the face slab, deflecting according to their elastic curves, gave the proportion of the load carried by cantilever and horizontally continuous beams. Designs for locks and dams are being prepared under the engineering supervision of A. E. Niederhoff, Assoc. M. Am. Soc. C.E., and Roy R. Clark, M. Am. Soc. C.E.



Frosty Eastern Rim of Willamette Basin

Curiously Uniform Alinement of the Three Sisters (Nearest Group of Peaks) with Mts. Washington, Jefferson, Hood, and Adams (Just Visible on the Horizon) as Seen from an Altitude of 17,000 Ft

For earth dams, recourse was had to the work of several investigators in soils mechanics supplemented by some additional experimentation. Samples of local materials were tested to determine their physical and chemical properties as well as their probable behavior in an embankment. A soils testing laboratory has been established, and its findings have aided materially in the orderly and economical conduct of construction work.

Each of the component parts of the entire project calls for the solution of specific problems. The reconstruction of the Willamette Falls locks, for instance, is complicated by their location in a congested, highly industrialized area. Rerouting of navigation during construction will be a major consideration to be settled with conflicting interests. In the matter of design, the hydraulic problem involved in quietly filling a lock under a high head when the initial depth of water over the lock floor is only 9$^1/_2$ ft has been solved in a unique manner. Hydraulic model experiments have indicated the desirable features of the structure shown in plan and elevation in Fig. 2. The estimated total cost of this improvement is $4,247,000.

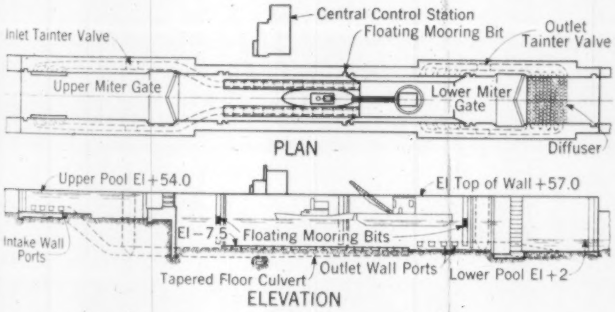


Fig. 2. Proposed Reconstruction of Willamette Falls Lock

Fern Ridge Dam is now nearing completion on the Long Tom River, a tributary of the Willamette. The concrete overflow structure is a gravity type founded on rock and surmounted by counterweighted, self-regulatory Tainter gates. Earth dikes, attaining a maximum height of 44 ft, flank both sides of the spillway. Costs, including right-of-way, damage, design, and construction, total an estimated $2,698,570.

Cottage Grove Dam, on the Coast Fork, is also under construction, a concrete-gravity overflow type 90 ft high. The foundation is a shale, portions of which disintegrate when exposed to alternate wetting and drying. Field tests established a sliding coefficient of 0.8 and a shear value of the rock of 10.8 tons per sq ft. This item of the plan is estimated to cost $2,441,160.

Plans for the Dorena Dam contemplate an earth dike nearly one mile long with a maximum height of 145 ft. The spillway is essentially a paved concrete chute over the right abutment. Outlet works will consist of a lined tunnel through the right abutment under the spillway section, emerging on the same apron used for overflow purposes. One cylinder gate having a diameter about one-half that used at Boulder Dam will control the flow through the outlet tunnel. Design problems are limited to obtaining an efficient, adequate structure from the hydraulic standpoint. The estimated cost is $4,257,000. Figure 3 shows the proposed dam in plan and section.

Dams proposed at Lookout Point, Quartz Creek, Sweet Home, and Detroit would be situated on tributaries of the main river. These include the highest dams in the project, one of which will ultimately reach 360 ft. Provisions for the future development of hydroelectric power have been included.

The adopted project for the Willamette River Basin includes $1,100,000 for improvement of the navigable channel between Oregon City and Albany. The improvement, together with the increased low-water flow made possible by releases from the storage reservoirs, will provide a channel 150 ft wide and 6 ft deep between Oregon City and Salem, and 150 ft wide and 5 ft deep between Salem and Albany. The improvement will involve removal of rocks, boulders, and gravel bars in this stretch of the river. Increased movement of logs and the shipment of bulk commodities to new industrial centers along the improved river will result as soon as the bottleneck at the old Willamette Falls locks is removed.

The solution of the migratory fish problems in the Willamette Valley was worked out in conjunction with the U.S. Bureau of Fisheries. Provisions for the passage or artificial propagation of migratory fish will be necessary at some of the proposed dams. Extensive and enlarged modern hatcheries are planned on some of the tributaries to replace or supplement the existing hatcheries. The regulation of flow from the reservoirs on the Coast Fork, and on the Row and Long Tom rivers will reduce peak flows and increase low-water discharges, thereby improving conditions for both resident and migratory fish life on the main stream. Studies of fish problems are being continued, and should result in improved conditions throughout the valley. Preliminary estimates indicate an expenditure of about $1,000,000 on this phase of the program.

MT. JEFFERSON FROM THE SOUTHWEST
Slopes in Foreground Are in the Willamette Basin

As previously indicated, no immediate facilities for the generation of electric power are contemplated under the plan for the initial development, but basic features will be incorporated in three of the dams to provide for the future installation of generating equipment when the production of electric power becomes justified. In addition to the construction of the power plants, the three dams in question would be raised to provide additional storage. When this is done, more complete regulation of stream flow will be possible, and power plants may then be economically installed at other sites.

An installed capacity for the ultimate development will approximate 413,000 kw. This will mean nearly two billion kilowatt hours of electric power annually, which is approximately equivalent to the output at Bonneville Dam. The military value of cheap power in the production of aluminum for airplane parts has already been demonstrated in the Pacific Northwest. It is interesting that the natural runoff conditions and the effects of the proposed Willamette Basin reservoirs would probably cause the peak capacities of any power plants constructed to be available at seasons of the year when the power output of the Bonneville plant is reduced by water shortage or by flood conditions. Conversely, Bonneville's peak capacity would be available at seasons of the year when the output of the Willamette Basin plants is reduced.

ULTIMATE IRRIGATION BENEFIT PLANNED

Much of the reservoir storage will provide an ultimate irrigation benefit. The plan so far authorized by Congress does not include construction of canals, laterals, or other features incidental to irrigation. Relative to this part of the program, the Engineer Department will cooperate with the Bureau of Reclamation and with irrigation districts as they may become interested. It is expected that the adoption of proper operating schedules would permit the ultimate irrigation of about 355,000 acres of Willamette Valley lands, all without detrimental effect on the navigation, flood control, or power features of the project.

According to Dr. W. L. Powers, specialist in soils for Oregon State College, successful irrigation of land in the Willamette Valley has increased from 3,000 acres in 1930 to 45,000 acres in 1940. Many new crops have been cultivated, among them ladino, a species of giant white clover used as pasturage and as feed. Green beans and other vegetable crops have been successfully grown by means of aerial irrigation. Several large canneries will accept no other vegetables than those grown on irrigated land because of their superior texture and taste. Diversity of crops through late spring and summer irrigation has resulted in the opening up of new fields of production each year. Complete use of the stored water may well result in an increase of from 30 to 110 % or an average increase of about 52%, in production of the principal crops now raised in the valley. Farm production, thus stepped up, will release man-power for other vital national defense projects. After the present emergency is over, the Willamette Valley will play its part in feeding the starving people in foreign countries.

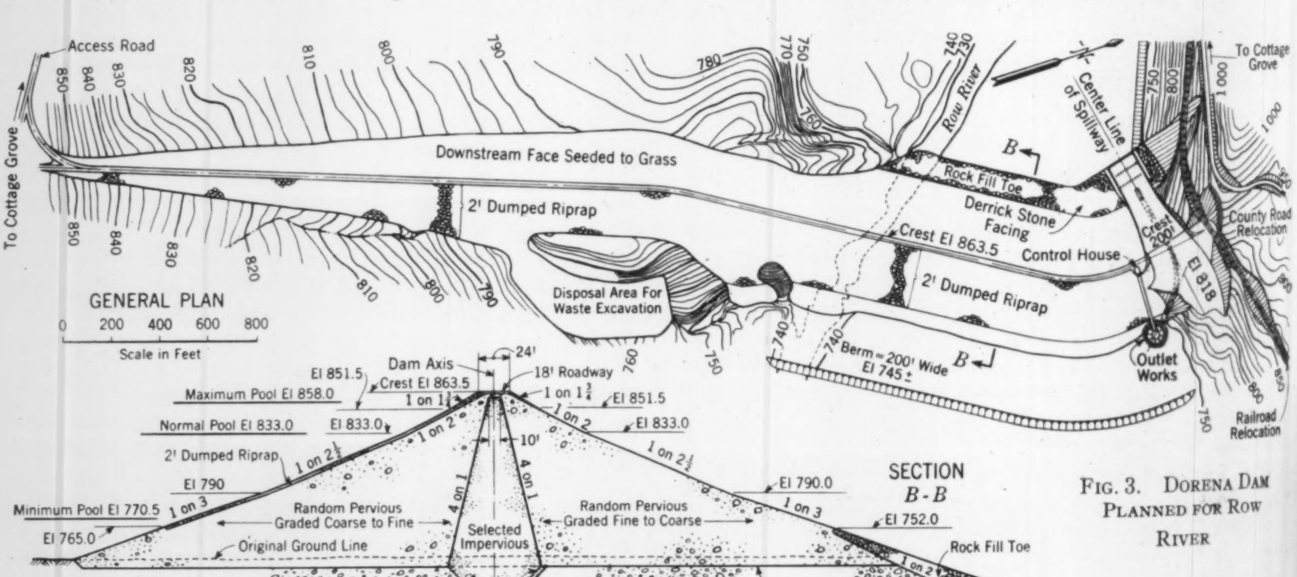

Access Road
To Cottage Grove
850
840
830
820
810
800
790
780
770
760
750
740
730
Row River
Center Line of Spillway
To Cottage Grove
1000
Downstream Face Seeded to Grass
Rock Fill Toe
B
Derrick Stone Facing
2' Dumped Riprap
Crest El 863.5
Control House
Crest 200'
El 818
County Road Relocation
2' Dumped Riprap
Disposal Area For Waste Excavation
Berm = 200' Wide El 745 ±
Outlet Works
Railroad Relocation
GENERAL PLAN
0 200 400 600 800
Scale in Feet
Dam Axis
24'
El 851.5
Crest El 863.5
18' Roadway
Maximum Pool El 858.0
1 on 1¾
El 851.5
Normal Pool El 833.0
El 833.0
1 on 2
10'
El 833.0
2' Dumped Riprap
1 on 2½
4 on 1
1 on 2½
El 790
El 790.0
Minimum Pool El 770.5
1 on 3
Random Pervious Graded Coarse to Fine
Selected Impervious
Random Pervious Graded Fine to Coarse
1 on 3
El 752.0
El 765.0
Original Ground Line
Rock Fill Toe
1 on 2
Impervious Foundation
1 on 1
3' Sand and Gravel Filter
Excavated to Pervious Foundation Gravels
SECTION B-B

FIG. 3. DORENA DAM PLANNED FOR ROW RIVER

Multiple-Purpose Reservoir Operation

Part II. In Combination Systems with Several Units

By Nicholls W. Bowden, M. Am. Soc. C.E.

Principal Hydraulic Engineer, and Head, River Control Section,
Tennessee Valley Authority, Knoxville, Tenn.

Utilizing water storage for the joint interests of flood control and power, formerly considered inconsistent and antagonistic, has proved feasible for single projects, as shown by Mr. Bowden's article in the May issue. Taking the TVA as an example, he explains in this paper how the many objectives of multi-purpose projects can also be attained in a large river system with a number of reservoirs. Operations in the interest of navigation and power are parallel. More difficult is the flood control, for which two general schemes are described. The results, aided by special weather forecasts, have been most gratifying—low flows have been more than doubled, to the benefit of navigation and power, and flood crests have been reduced by as much as 5 ft or more.

Since projects of the Tennessee Valley Authority (TVA) form a system of reservoirs within a single river basin, they are interrelated and must be operated as a unit. This paper will discuss the problems involved. A previous article in the May issue dealt with single reservoir projects independently operated for multiple-purpose use.

The Authority's water-control program is directed toward the "impounding and release of water...to assure the maximum use of facilities and resources available for flood control, navigation, and other purposes consistent with the requirements of the Tennessee Valley Authority Act..."; and toward defining from time to time "the extent to which water may be impounded and the stream flow limits within which impounded water may be used for the generation of electric energy." Other purposes include sanitation; recreation; the control of malaria; aiding construction work in, along, and over the river; and aiding aquatic and other wild life.

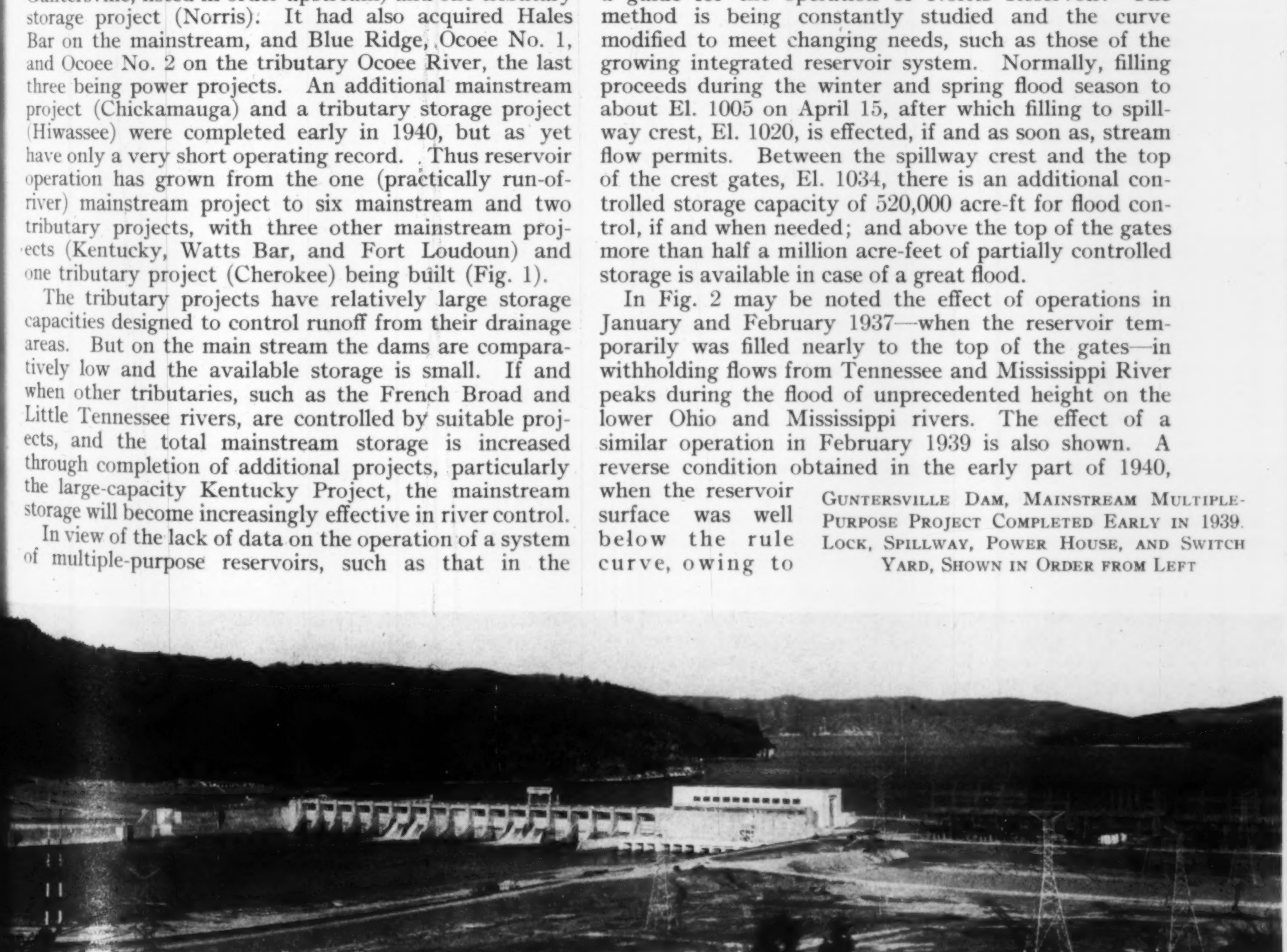
When the Authority was created in 1933 it took over the Wilson Dam project (Fig. 1). By December 1939 it had completed and placed in operation three other mainstream projects (Pickwick Landing, Wheeler, and Guntersville, listed in order upstream) and one tributary storage project (Norris). It had also acquired Hales Bar on the mainstream, and Blue Ridge, Ocoee No. 1, and Ocoee No. 2 on the tributary Ocoee River, the last three being power projects. An additional mainstream project (Chickamauga) and a tributary storage project (Hiwassee) were completed early in 1940, but as yet have only a very short operating record. Thus reservoir operation has grown from the one (practically run-of-river) mainstream project to six mainstream and two tributary projects, with three other mainstream projects (Kentucky, Watts Bar, and Fort Loudoun) and one tributary project (Cherokee) being built (Fig. 1).

The tributary projects have relatively large storage capacities designed to control runoff from their drainage areas. But on the main stream the dams are comparatively low and the available storage is small. If and when other tributaries, such as the French Broad and Little Tennessee rivers, are controlled by suitable projects, and the total mainstream storage is increased through completion of additional projects, particularly the large-capacity Kentucky Project, the mainstream storage will become increasingly effective in river control.

In view of the lack of data on the operation of a system of multiple-purpose reservoirs, such as that in the Tennessee Basin, it has not been possible to turn elsewhere for guidance; neither has any generally accepted theory of operating such a system been available. Experience there is relatively brief, since only two reservoirs have been in operation for as long as five years and since data for only one year have been obtained for all eight reservoirs acting together. While the results thus far attained have been gratifying, perhaps even exceeding expectations, there is much yet to be learned. Those closest to daily operations realize, possibly more than others, that all the answers to problems which arise are not readily apparent. They expect to learn much through experience, and it may be that the Tennessee Valley will be the testing ground for developing far-reaching principles for operating such systems.

In Fig. 2 is shown the "rule curve" which serves as a guide for the operation of Norris Reservoir. The method is being constantly studied and the curve modified to meet changing needs, such as those of the growing integrated reservoir system. Normally, filling proceeds during the winter and spring flood season to about El. 1005 on April 15, after which filling to spillway crest, El. 1020, is effected, if and as soon as, stream flow permits. Between the spillway crest and the top of the crest gates, El. 1034, there is an additional controlled storage capacity of 520,000 acre-ft for flood control, if and when needed; and above the top of the gates more than half a million acre-feet of partially controlled storage is available in case of a great flood.

In Fig. 2 may be noted the effect of operations in January and February 1937—when the reservoir temporarily was filled nearly to the top of the gates—in withholding flows from Tennessee and Mississippi River peaks during the flood of unprecedented height on the lower Ohio and Mississippi rivers. The effect of a similar operation in February 1939 is also shown. A reverse condition obtained in the early part of 1940, when the reservoir surface was well below the rule curve, owing to



Guntersville Dam, Mainstream Multiple-Purpose Project Completed Early in 1939. Lock, Spillway, Power House, and Switch Yard, Shown in Order from Left

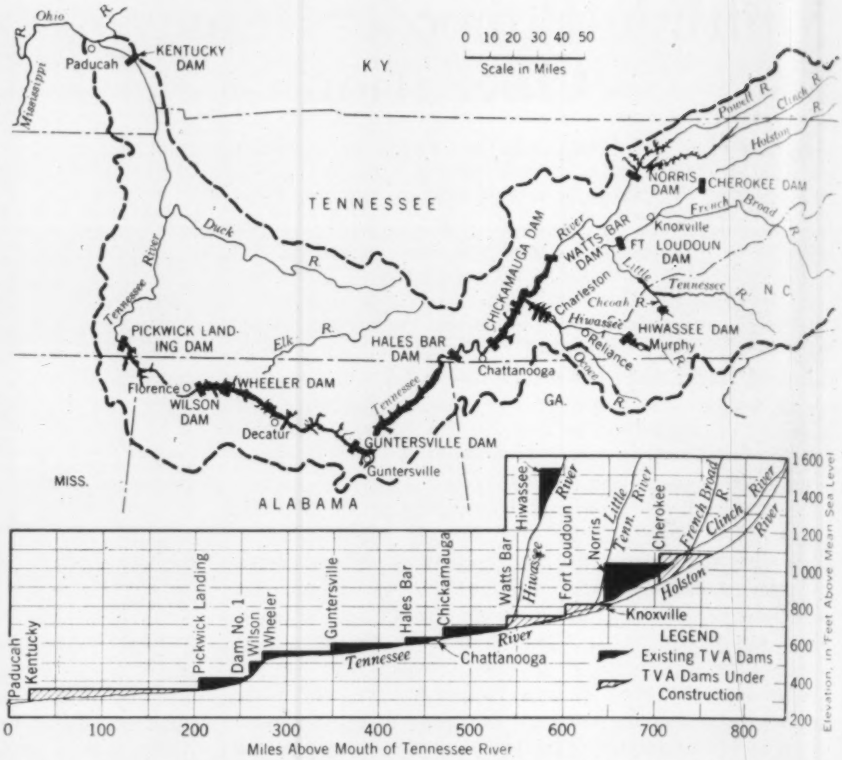

Ohio R.
Mississippi
Paducah
KENTUCKY DAM
KY
0 10 20 30 40 50
Scale in Miles
Powell R
Clinch R
Holston R
NORRIS DAM
CHEROKEE DAM
French Broad R
Knoxville
FT LOUDOUN DAM
WATTS BAR DAM
Little Tennessee R
N C
TENNESSEE
Duck R
Tennessee River
CHICKAMAUGA DAM
Charleston
Chcoah R
Hiwassee
Reliance
HIWASSEE DAM
Murphy
PICKWICK LANDING DAM
Elk R.
HALES BAR DAM
Chattanooga
Ocoee R
GA.
Florence
WHEELER DAM
WILSON DAM
Decatur
GUNTERSVILLE DAM
Guntersville
MISS.
ALABAMA
Paducah
Kentucky
Pickwick Landing
Dam No. 1
Wilson
Wheeler
Guntersville
Hales Bar
Chickamauga
Watts Bar
Hiwassee
Fort Loudoun
Norris
Cherokee
Knoxville
Chattanooga
Tennessee River
LEGEND
Existing TVA Dams
TVA Dams Under Construction
0 100 200 300 400 500 600 700 800
Miles Above Mouth of Tennessee River
200 400 600 800 1000 1200 1400 1600
Elevation, in Feet Above Mean Sea Level

FIG. 1. THE TENNESSEE VALLEY AND ITS RESERVOIR DEVELOPMENT

sustained draft for navigation and power during the exceptionally long drought.

Usually drawdown of the reservoir for mainstream water supply begins in the late summer and extends to around the end of the year, when some 2,000,000 acre-ft of storage space again has been provided for subsequent flood regulation. This very large storage capacity, equivalent to about $12^1/_2$ in. of runoff over the contributing drainage area, without taking into account the partially controlled flood-storage capacity above the top of the gates, provides quite effective flood control. Since the average annual runoff above the dam is only about $21^1/_2$ in., the capacity considerably exceeds the criterion recommended by E. H. Sargent, M. Am. Soc. C.E.—namely, that a multiple-purpose reservoir should have available storage equivalent to at least 50% of the mean annual runoff at the site.

The filling of this reservoir during the flood season is obviously beneficial to flood control, and likewise to navigation and power development, for which the stored water is to be used later. The need for the actual release of the stored water for navigation to augment low flows in the late summer and fall is largely parallel to that for power, so that the storage space made available in the reservoir, in the process of meeting these two needs, is in turn subsequently used for flood control.

All the completed mainstream projects of the TVA are much alike and are operated in similar manner. They were designed, constructed, and are being operated, to serve the same multiple purposes as the Norris tributary project, but their location on a navigable stream necessarily had considerable influence in determining such features as dam sites, height of dams, lifts, pool elevations, and fluctuations. In each case the flood storage is superimposed on the navigation pool, which is fixed at an elevation needed to furnish suitable depths in the pools, over the upper miter sill at the entrance to the downstream lock and over the lower miter sill at the upstream lock. The navigation pools become the minimum reservoir levels and may not be encroached upon for other purposes. They fix minimum headwater and tailwater elevations for the turbines at each project.

These mainstream multiple-purpose projects have permissible pool fluctuations varying from about 3 ft at Wilson to about 10 ft at Pickwick. They provide a total controlled flood storage of only a little more than one million acre-feet, equivalent to a runoff of less than one inch, and of course sufficient to effect only small reductions in large flood flows. However, the completion of the Kentucky Project on the mainstream near its mouth (Fig. 1), and within one day's water travel from the Mississippi River, will increase greatly the effectiveness of the entire system. This project has a controlled flood storage capacity of more than 4,000,000 acre-ft. The operating diagram for the Wheeler Project, Fig. 3, is more or less typical for the existing mainstream projects. After about January 1 each year the water surface of that reservoir is maintained at about El. 550 until the end of the flood period, around April 1, except when the reservoir is being used in regulating floods.

In such cases—and there may be several during the flood period—the storage space between El. 550 and El. 556.3, or as much thereof as may be needed, is used. When flood flows are imminent, the reservoir may be lowered in advance (but not below El. 548) and then refilled, or partly so, in reducing the flood peak. As soon as the flood has passed, the reservoir is lowered again to the range 550 to 552 in readiness for regulating subsequent floods. Late in March or early in April, depending on weather and stream-flow conditions, the reservoir is filled to the top of the gates, El. 556.3, then lowered in a few days to El. 556. This helps to strand floatage, prevents the growth of vegetation along the banks in the interest of malaria control, and provides storage for use through the turbines and for navigation.

Between May 15 and October 1, weekly fluctuations in the pool are made one foot deep or deeper if stream flow is adequate, and after July 1 a gradual drawdown is made to about El. 553, all for malaria control. If stream flow remains low, as in 1939, the reservoir may be drawn down to minimum El. 550 to supply water for maintaining navigable depths and for turbine use. If flows increase sufficiently in the fall, it may be refilled to El. 555 or 556 to provide additional head and water for use if needed. Late in December it is again lowered to the winter level to be ready for flood-control operations.

Even for a single multiple-purpose reservoir, successful operation is not a simple task. Obviously it is of prime importance always to know what the inflow is and what is to be expected in the immediate future. Although great improvement has been made in recent years in estimating runoff from rainfall, inaccuracies still occur. Even when the water reaches a stream, uncertainties are present due to errors in station ratings. The expected inflow is dependent on weather conditions—whether it will rain, and if so, when, where, and how much. These predictions are difficult, but the Authority is attempting to solve the problem through cooperation with the U.S. Weather Bureau.

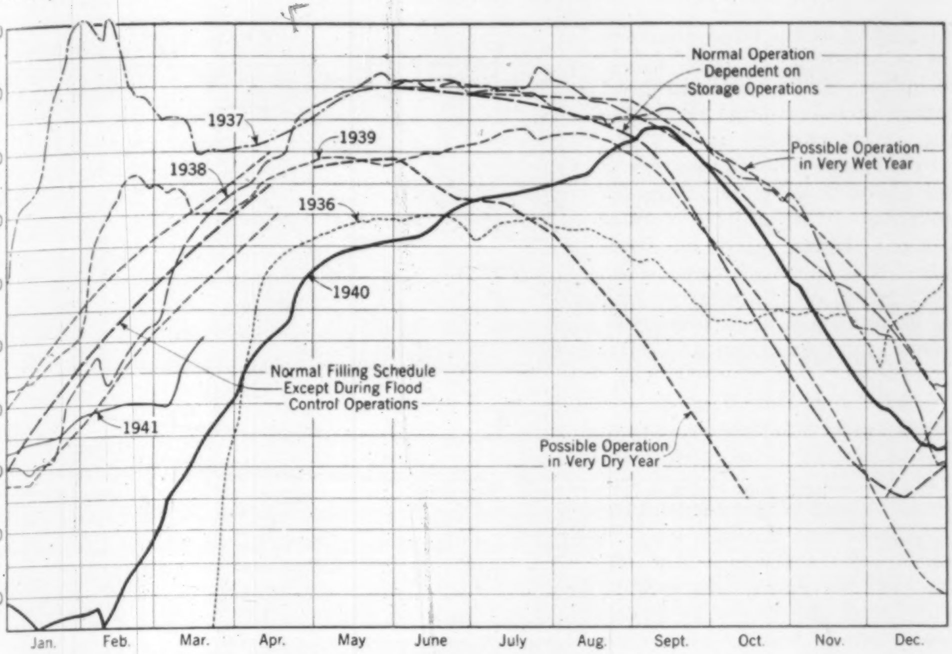


Fig. 2. Norris Reservoir Operation—Actual and Idealized

At the beginning of the 1939–1940 flood season, the Weather Bureau, using specially trained personnel, initiated at Knoxville a new experimental forecasting service covering the Tennessee Basin for the benefit of the Authority in its river-control work. New methods of weather forecasting by air-mass analysis are used, to furnish quantitative forecasts of precipitation 36 to 48 hours in advance for different sections of the basin. Although this service is in its infancy, results indicate considerable possibilities and it seems destined to spread over the country as the forecasts increase in reliability.

It is convenient to fill tributary storage reservoirs in high flow periods for regulating floods when there is sufficient flow downstream for navigation and for energy generation at the mainstream dams. The high head and the large volume of water thus stored are ideal for turbine operation and for navigation in the low-flow period when flows at the main-river plants are at a minimum. In the case of a mainstream reservoir, the maintenance of its pool at or above minimum navigation level affords suitable head for power, and drawdown in the low-flow period provides water to supplement that from tributary reservoirs. Thus navigation and power development are parallel operations.

While navigation and power uses require careful planning to accomplish the best regulation of flow, particularly during droughts and floods, the most difficult and exacting operation is that for flood control. It is difficult because there may be, and usually are, so many rapidly changing factors, such as rainfall, runoff, and time of water travel. And it is exacting because, in order to get and keep control of the flood, it is absolutely essential to make decisions and put the necessary operations into effect at the earliest possible time and then to "carry on" until the flood has passed. A wrong decision or one too long delayed may result in failure to reduce the flood peak or in a lesser degree of regulation.

On the approach of a flood, storing is begun in the tributary reservoirs and is continued as long as necessary to withhold undesirable contribution from the flood peak at Chattanooga, or other critical points in the valley, and even at Cairo, Ill., if the lower Mississippi River should also be in flood. The operation of these units in the system modifies the flood as it passes downstream.

The mainstream reservoirs are held at about minimum elevations for navigability at their upper ends. They may be lowered at the downstream ends of the pools as the flows increase, producing steeper slopes and greater depths upstream. The prompt lowering of pools is very desirable, inasmuch as this tends to prevent the dissipation of flood storage space in the reservoirs during the early stages of the flood, which should be retained for use during the period of peak flow. If drawdown can be begun soon enough—and this is dependent on reliable advance rainfall and runoff forecasts as well as on prompt operation of the dams—the main-river projects can be made more effective for flood control because of the relatively large storage volume in the lower end of the reservoirs that can be made available.

In operating the mainstream system, two general methods are shown in Fig. 4. Conditions are intentionally exaggerated to bring out the different features more clearly. Furthermore, operations depicted are ideal, hence hardly attainable in practice.

In Fig. 4 (*a*), *AHDG* represents a hypothetical flood hydrograph at Pickwick Landing Dam, unregulated except by tributary reservoirs. If the storm rainfall has been intense over the local area tributary to the system and then has moved upstream, as is sometimes the case, the inflow into the mainstream reservoirs will increase rapidly and reach a peak sooner than the natural flow, as indicated by the curve *ABCEE′G*. If the flood comes from upstream and is not augmented by local inflows, the system inflow and the natural flow may be more nearly the same both as to height and time of peak. The system inflow, which is of course the same in total volume as the natural flow represented by *AHDG*, must be considered in the operation of the reservoir system. To reduce the flood peak as much as practicable, the discharge from the system should be steadily increased, beginning as soon as practicable, say at *A*, to maintain as much storage space as feasible in the system for use during both the system inflow and natural peaks. The sooner the increase in system release is begun, the less rapid the change will have to be to accomplish the same regulation.

The curves *ABEFG* and *AB′E′F′G*, Fig. 4 (*a*), indicate very effective methods of regulating a flood in that they adequately take care of the system inflow and reduce the natural flood peak. The two methods differ principally in the promptness with which discharges are made from the system in the early stages of the flood, as shown by *AB* and *AB′*, the former getting rid of the water as fast as it enters the system and the latter somewhat faster. Considering the corresponding system storage, Fig. 4 (*b*), under method *AB* the volume of water remains constant until storage begins at point *B;* and under method *AB′* the volume is somewhat reduced until storage begins—that is, at the time when the discharge equals the inflow or where *B′F′* (Fig. 4 (*a*)) intersects with the system inflow, *ABC*. In both cases the volume of water in storage increases until the water being released exceeds the inflow, points *E* and *E′*, Figs. 4 (*a*) and (*b*). Then discharge may be continued as indicated to *F*, *F′*, and *G*, or it may be gradually reduced, in either case returning eventually to normal system inflow when the desired storage space has been made available in the system. The speed with which the stored water is released will depend on the weather and the prospects of a recurring flood as well as on flood conditions downstream, particularly on the Ohio and Mississippi rivers.

In a general way, Fig. 4 (*c*) shows the effect on the profile of the system during the course of this operation. Perhaps the best way to visualize this is to think of all mainstream reservoirs in the system as one large reservoir. The profile designated "*A* and *G*" represents the water surface in that reservoir before the operation is begun and after it is completed. Curves *B* and *B′* show the effect on the slope in the reservoir as the flood is building up in the system and the discharge is increased up to *B* and *B′*, as shown in Fig. 4 (*a*). Note that in both cases the slope steepens as flows increase.

In the case of profile *B*, the volume of water in the reservoir would be the same as before the operation began, the drawdown at the lower end compensating for the water stored in the upper end. In the case of profile *B′*, there would be less water in storage than before the flood began. Profiles *E* and *E′* represent the time when the volume of water stored in the reservoir is greatest, the storage space between the *B* profiles and the *E* profiles having been filled. Subsequently, the water surface is returned to the original condition, as represented by profile "*A* and *G*," when the release of the flood storage has been completed.

No two floods are exactly alike, hence no stereotyped method of reservoir operation for effective regulation can be prescribed in advance. The operations described were not intended to be rigid but to draw attention to some of the basic features of a flood-control operation.

Although the existing TVA reservoir system is highly inadequate at present for the complete regulation of a river having a length of over 650 miles, exclusive of an extensive tributary system, and a natural range in flow varying from 5,000 to over 450,000 cu ft per sec, the following important results have been accomplished in operations:

1. Throughout the low-flow periods in each of the last four years, navigation on the Tennessee River has been materially benefited by release of stored water in an amount up to more than 100% in excess of natural flows, thus increasing depths by something like 2 ft. These releases have been beneficial also on the Ohio and Mississippi rivers, increasing low flows on the latter by perhaps 10%, and depths in the Cairo-Memphis reach by more than one-half foot.

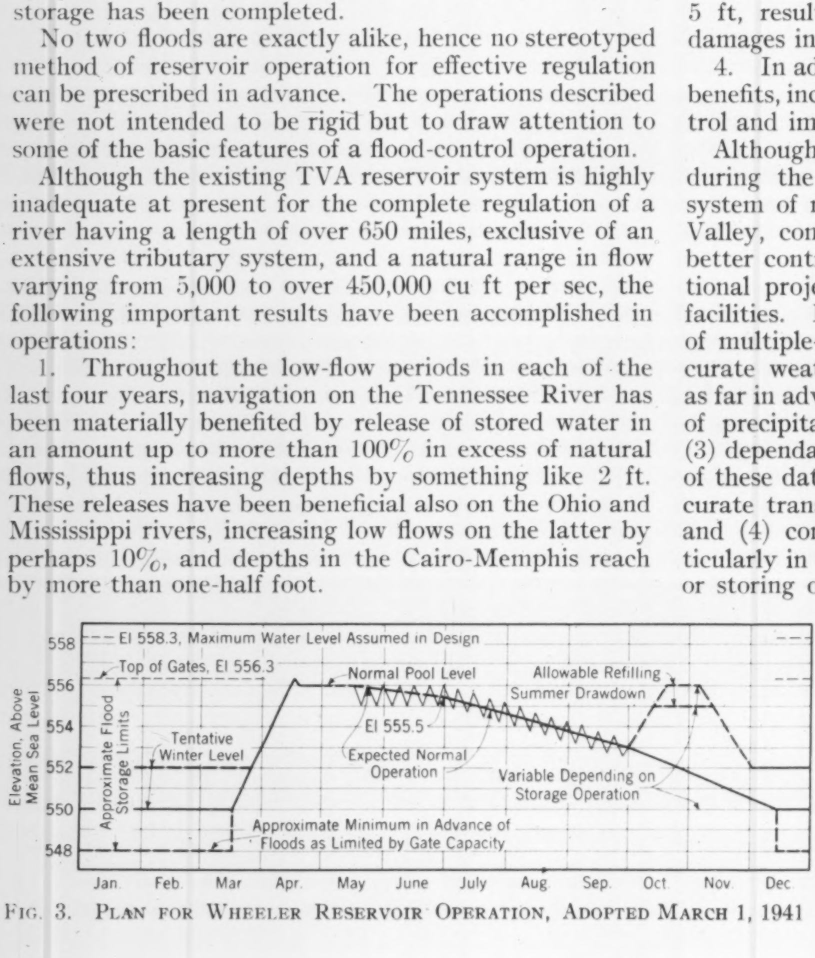


FIG. 3. PLAN FOR WHEELER RESERVOIR OPERATION, ADOPTED MARCH 1, 1941

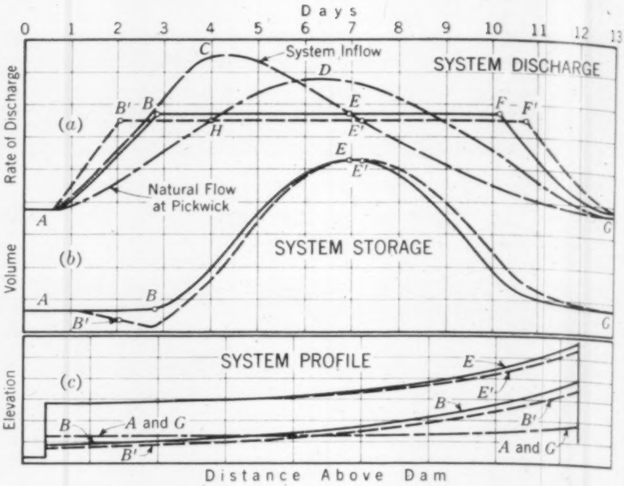


FIG. 4. DIAGRAMMATIC SKETCHES—OPERATION OF MAINSTREAM RESERVOIR SYSTEM

2. This more than doubling of low flows in the Tennessee River has been equally beneficial in the production of power, making possible the conversion of considerable quantities of energy from secondary into primary power. The increase in primary power at Wilson and Hales Bar dams, the two mainstream plants in operation throughout, amounts to some 90,000 kw. Hydro power production has shown a rapid, continuous growth.

3. Even with the relatively small volume of flood storage available, the reduction of flood crests along the Tennessee, Ohio, and Mississippi rivers has been substantial in some cases. Studies show that seven crests at Chattanooga, which would have exceeded flood stage, have been reduced materially, in one case by more than 5 ft, resulting in a total estimated savings in flood damages in that city alone of nearly $3,000,000.

4. In addition there have been many other incidental benefits, including a material improvement in malaria control and improved sanitary and recreational conditions.

Although much pioneering work has been necessary during the first five years of operating the growing system of multiple-purpose reservoirs in the Tennessee Valley, considerable success has been attained. Even better control of stream flow may be expected as additional projects are completed, thus increasing storage facilities. Elements essential to the successful operation of multiple-purpose reservoir systems include: (1) accurate weather forecasts, particularly of precipitation, as far in advance as possible; (2) accurate measurements of precipitation and runoff at selected key stations; (3) dependable and prompt transmission and assembling of these data at a central point and their quick and accurate translation into present and prospective runoff; and (4) constant attention and prompt decision, particularly in time of flood, in determining the dispatching or storing of water in the system by a competent, experienced hydraulic engineer who has an intimate knowledge of the characteristics of the system and freedom of action in initiating operations and deciding methods to be employed in reaching the desired objectives.

The writer is grateful to Sherman M. Woodward, M. Am. Soc. C. E., Chief Water Control Planning Engineer, and to J. H. Wilkinson, Assoc. M. Am. Soc. C.E., Head of the River Forecasting Section, both of the TVA, for their valuable assistance.

Road Work in Theaters of Military Operations

Part II. Training Needs and Techniques

By William N. Carey, M. Am. Soc. C.E.

Colonel, Corps of Engineers; Assistant to the District Engineer, Jacksonville, Fla.

It is probably safe to say that American troops will never be employed in somebody else's war purely for training purposes as were those of some nations in the recent Spanish civil war. If our military engineer forces are to operate efficiently in their first engagement, it seems axiomatic that some means must be found for duplicating in their peace training the whole gamut of war conditions, from filling shell holes in the dark to substituting bituminous surfacing for mud roads in competition with blitzkrieg military traffic. Colonel Carey recognizes this need and offers a plan. Some of the comments he makes here were originally presented in discussion of Colonel Godfrey's paper presented before the Highway and City Planning Divisions at the Baltimore Meeting of the Society. This is the second of three articles on military roads that have been made available through the courtesy of the Chief of Engineers, U.S. Army.

The principal function of our combat engineers is to "make passable and keep passable the routes over which our own forces advance and to make impassable . . . the routes over which the enemy may advance" (Maj. Gen. Julian L. Schley, Chief of Engineers, U.S. Army, "The Engineer and National Defense, *The Military Engineer*, Nov.-Dec., 1940"). From this positive function, with its negative corollary originate the duties and the difficulties of that section of the engineer service charged with responsibility for roads. Not only must the military engineer today have "knowledge of all means of road construction and maintenance," in all their myriad practical and technical details, but he must be able to apply that knowledge successfully under any set of conditions and with any material that happens to be available. In addition, he must be able to accomplish any road task with a minimum of time and equipment. Our military engineer on road work, to be equipped adequately for his task, must possess the knowledge and experience of a competent civil highway engineer plus the military knowledge necessary to apply and adapt his highway engineering knowledge and experience to military requirements. As to the application of these principles, it should be stated at the outset that, except where quotation marks are used, the observations, opinions, and recommendations made in this article are those of the author. They do not necessarily reflect official Army views and in some instances, at least, may be at variance with them.

"The present theory controlling road work in forward areas is based on the doctrine of reconstruction, repair and maintenance of existing roads rather than that of the construction of new roads" (Capt. J. M. Young, Corps of Engineers, 1937 Report). This doctrine does not justify the assumption that new roads will never be constructed in modern warfare. Even with all the roads we possess in the United States, the development of a theater of military operations in any area would be almost certain to require some new roads. However, new roads would not be constructed unless those already existing could not be made adequate. With the new-style army, motorized and on wheels, the handicap of distance is sharply reduced and the real need for new road construction correspondingly diminished.

Since we cannot rule out the possibility that special circumstances may require new construction, the engineer officer must have knowledge of how to carry it out under any set of conditions. He must be able quickly to construct roads that will be of maximum usefulness with the simplest of tools and plant, and probably with few experienced road construction men. The writer has observed that most regular army engineer officers have had all too little experience in the highway field and that the civilian highway engineers, generally, have little or no knowledge of the military field. The experienced highway engineer, transformed by war into an engineer officer, has much to learn before he can do a creditable job of building or maintaining roads under the restrictions of army plant, personnel, and material in a battle situation.

Few of the facilities familiar on most modern highway construction jobs are likely to be available to engineers in forward areas in war. The principal road equipment now prescribed for engineer troops in our army consists of bulldozer-angledozers on medium tractors, small air compressors with tools and drills, $^3/_8$ and $^1/_2$-yd power shovels, motorized blade graders, tractors, $1^1/_2$-ton dump trucks, other trucks and transport trailers, demolition equipment, and small tools. Additions to this equipment are under way at present, as is also the engineer organization to operate the special types of construction plant as well as future additions and variations. Effective peace-time training of engineer troops for road work cannot be had until such troops can be furnished the road plant and equipment that will be available to them in war, and until they know, in a general way at least, what repair and maintenance materials are likely to be available.

Except for the limitations placed on road construction in forward areas by restricted construction equipment and by battle conditions, such construction follows civilian practice generally. The fundamental principles are about the same in war as they are in peace but military standards as to grades, curvature, and surface requirements are much lower than civilian standards. Good drainage always is a basic requirement. The time

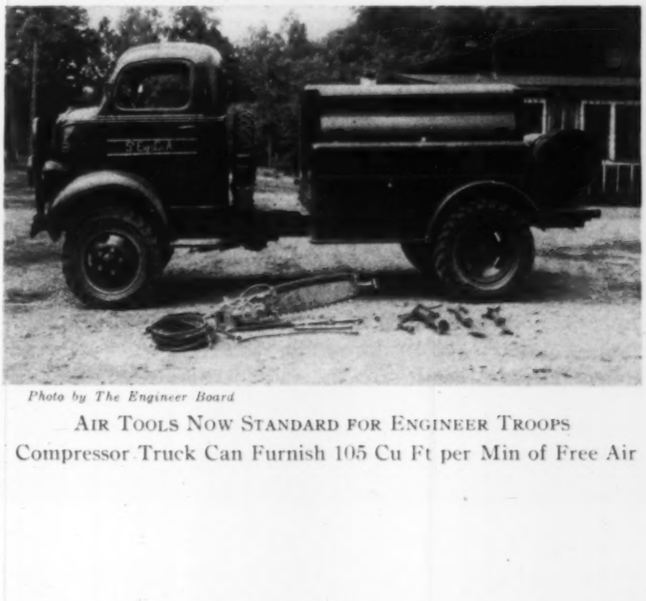


Photo by The Engineer Board

Air Tools Now Standard for Engineer Troops

Compressor Truck Can Furnish 105 Cu Ft per Min of Free Air

Photo by U.S. Signal Corps

HAND OPERATIONS OF A.E.F. DAYS
Rock and Mud Work by the 315th Engineers in France—Fay en Haye, September 1918

element eliminates heavy cuts or fills from temporary military construction, as it is always preferable to go up, down, and around with a new road rather than to attempt civilian standards of grade and alinement. In forward areas, long-range planning covering location and types of new roads is relatively futile. Fast changing military situations make paramount the road requirements of the moment. Tomorrow may bring new and different requirements. The use of locally available materials to the greatest practicable extent, especially for road surfacing, always has been a fundamental doctrine of the military engineer. Upon the skill with which this doctrine is applied usually depends the success or failure of any military construction enterprise in a forward area.

Above all technical and practical considerations in forward areas always stands the formidable and completely controlling element of time. In civilian practice, time is usually of importance, but if a project is not complete and ready for use on the agreed date, the damage is nominal, and the project is 100% useful when it is complete. In a battle, however, construction must be ready for use at the time agreed upon or ordered, for a failure to complete may cause the loss of an entire tactical effort. Perhaps the most difficult faculty to develop in a military engineer from civil life or from a peace-trained army is a sound and accurate judgment as to the time required under a given set of circumstances under battle conditions to perform a given construction task.

All that has been said about road construction up to this point applies equally to road maintenance. Since new roads never will be constructed where existing roads can be made to serve, the work of maintenance, repair, and major improvement of existing routes will greatly overshadow that of new construction. These problems are far more complicated than construction problems. In addition to all the usual civil troubles, there are to be reckoned with: (*a*) the effect of explosives—shells, bombs, mines; (*b*) the probable dearth of easily adaptable repair material; (*c*) the importance of making repairs in the shortest possible time regardless of weather conditions; (*d*) a lack of heavy highway equipment and plant; and (*e*) enemy fire.

Under battle conditions, as in peace, road maintenance is carried on by localized gangs charged with the maintenance of definite road sections or by maintenance patrols who keep on the move back and forth over relatively long road stretches. All types of roads under traffic require maintenance and all types would require some maintenance if they carried no traffic at all. Every division or larger unit in combat develops a definite road net for its own use in its own area. The road net is planned for projection forward, with the necessary changes and adaptations, so that the road needs of the unit will continue to be met as the unit advances. Naturally, such a road net is developed, in so far as the tactical situation will permit, so that the best roads inside the unit boundaries will carry the heaviest traffic. This ideal is seldom attained except on selected map problems. In the field, however, the right roads persist in being in the wrong places. When the situation forces heavy traffic onto poor roads, the lot of the responsible engineer officer is not a happy one, especially in wet weather or in cold climates when the frost is leaving the ground. Once a road net for an operation is decided upon and circulated, the establishment of major detours or departures from it in action is most difficult. It is squarely up to the engineers of army, corps, and divisions to keep the roads of an adopted road net passable regardless of traffic, weather, enemy action, and any and all other destructive or delaying circumstances that may have to be dealt with.

In addition to simple maintenance, some parts of the road net are almost certain to require repair and reconstruction. Craters are common repair causes; these result from shells, bombs, and mines, and range in size from the volume of a bushel basket to a hundred or more feet in diameter and thirty or forty feet deep. Road culverts, small and large, frequently are blown out by a retreating enemy and the road blocks thus formed often result in repair jobs that tax the most ingenious. Other frequent sources of trouble are short stretches of unimproved, narrow rural roads which require quick transformation into heavy-traffic routes. Usually these are transverse roads required to form a connection in the traffic loop. This type of situation usually develops in a reconstruction job.

Because our army transports of all kinds have been placed on pneumatic tires or caterpillar tracks with plenty of power behind them, the high surfacing standards of civil practice are unnecessary. The recent extensive east Texas maneuvers proved that an army on wheels can successfully negotiate rough terrain. However, under some circumstances, this new-found ability to move large units at high speeds tends to impose higher standards than would be required by individual units of transport. If a road between two important points is passable during an action and can be kept passable for speeds not to exceed five miles an hour, it would be a waste of time and effort to maintain some part of the stretch to permit higher speeds. On the other hand, if the same road permits traffic to roll at forty miles an hour or better throughout the stretch, it is desirable to attempt to maintain that standard throughout. The inclusion of a bad section in an otherwise high-speed stretch usually results in a pile up of traffic behind the bad section and provides a good target for an alert enemy. Good road maintenance and repair will provide long stretches with uniform surface standards.

Given a general understanding of the probable road tasks of engineers in an active theater of operations, the question logically arises as to how the work can best be done. For highway engineers who will become engineer officers and for officers of the Corps of Engineers who already are engineer officers, it is believed that the best way to learn how to build and maintain roads tomorrow under war conditions is to practice today under simulated war conditions.

The large-scale maneuvers held in the past few years have served well in the tactical training of engineers but have been of little value in developing their technical training. The civilian character of the areas in which these maneuvers were held has in itself prevented the kind of construction work that would provide real technical experience. For all practical purposes, it is safe to state that no roads were constructed and, except for some wet-weather troubles, no roads were required to be maintained by army engineers under genuinely simulated battle conditions in any of these maneuvers. Engineer troops should have their own area in which to blast, manufacture road metal and road repair mixtures, and construct and maintain simple roads. They should also be trained in the maintenance of stretches of existing roads under civilian traffic and under all weather conditions.

Shaping and Ditching with Army's Modern Blader

Decisions as to military engineer road plant and engineer organization having been made and equipment procured, steps toward effective engineer training on road work would not be difficult. From the Regular Army, the National Guard, the Organized Reserve, and drafted men, appropriate organizations could be made, equipped, and put to work at separated "proving grounds" all over the country. After engineer recruits have received a short term of basic engineering and military training, the use of trial areas or proving grounds by new engineer units might be considered. There such units could learn to perform simulated war tasks with the men, equipment, materials, and under conditions, likely to be present in war. After engineer troops have learned the purely engineering phases of their responsibilities, they might then be fitted into the training operations of divisions, corps, and field armies. Every individual workman on a job must know his own tools well before he can render successful service as part of a construction organization. This appears to be equally true of an engineer organization which is to become a part of a larger military unit.

Photo by U.S. Signal Corps

Road Shaping and Ditching by the 304th Engineers—St. Remy, France, October 1918

Obviously there is no single material or method universally useful for all engineer road tasks. Full use always should be made of any expedient that can be devised to complete the required job with the least expenditure of time and material. However, the writer believes that bituminous materials afford an agency through which most tasks of road-surface maintenance or improvement can be performed with the least effort and with the greatest probability of success. In a war on this continent, road tars, road oils, cutbacks, and asphalt emulsions could be made easily available. All highway engineers of the country are familiar with the use of some or all of these bituminous materials. Mixes for cold laying can be made with a minimum of plant. It is as true at present as it has been in the past that serviceable road repairs and reconstruction in forward areas can be made without the use of bituminous materials, but such work can be done better in most cases with their aid. Engineer plant should therefore be selected and engineer training so conducted that full use may be made of such methods in forward areas.

On the other hand to provide engineer plant, equipment, and training based solely upon the prospective use of bituminous materials would be as much a mistake as to omit bitumens from consideration altogether. A thorough knowledge of other methods is essential, and is even prerequisite to the proper use of bituminous materials. The venerable slogan of the military engineer, "Get the water off and the rock on," has lost none of its verity with the modernization of highway engineering.

For repair, maintenance, and surfacing, the use of crushed rock or gravel can be made to answer the purpose but, with a bituminous binder, these road metals will serve better and longer. If no rock or gravel is available, sand and a bitumen alone can be made to give excellent road service. Highway engineers of Florida, North Carolina, and other states where rock and gravel are scarce, have developed methods for utilizing bituminous sand road mixtures that produce road surfaces and repair patches equal to those secured with the best of metals. Where sand and some clay are available but no bituminous material, there remain the possibilities of sand-clay or sand-clay-calcium chloride stabilization. These developments are of importance to the military engineer, to whom sand as a repair or surfacing material always has been something definitely to be avoided. Other recent developments throughout the country in low-cost materials combining local resources with bituminous binders are of equal value, and provision should be made for their military utilization.

TRUCK-TYPE BITUMEN DISTRIBUTOR

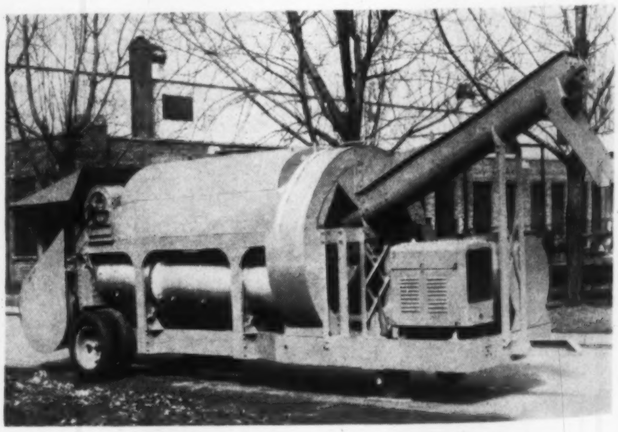
One-Half Road Width Application in Minnesota—Equipment of a Type Under Consideration for Use with Engineer Troops

Bituminous materials have a wide variety of uses, from the application of a light prime coat to the construction of cemented mats or macadams up to 3 in. or more in depth. For repair and maintenance purposes, bituminous materials can be mixed on or off the road without materially curtailing the usefulness of the road. These mixtures can be stored in large or small quantities and are ready for immediate use from stock pile. Bituminous materials can be transported in trucks to any place a truck can be driven. No barricades are required to protect fresh-made bituminous patches, and traffic is free to move over them as soon as they are placed. With bitumen as a binder almost any kind of locally available aggregate can be mixed to make a satisfactory patching or surfacing material. There is also a wide latitude for selection among the different types of suitable bitumens. Elaborate mixing plants are not necessary. Small, portable plants completely adapted to military use are now commercially available. Standard concrete mixers also are useful, especially with asphalt emulsion. In the absence of a mixing plant, a single blade grader under favorable conditions can mix several hundred tons of bituminous patching material in a single day. Bituminous road repairs are waterproof and are not easily displaced by traffic. In fact, rubber-tired or caterpillar-tread traffic usually improves a bituminous road patch.

In the preparation of cold lay mixtures there are no serious technical hurdles for engineer officers to overcome. Given a certain bituminous material—be it tar, road oil, cutback, or emulsion—and crushed rock, pit-run gravel, or plain sand, it is a relatively simple matter to determine quickly the respective quantities of bitumen and aggregate which should be combined to make a suitable surfacing or repair mixture. The only laboratory equipment needed is four or more standard sieves and a field book containing appropriate tables or curves. The quality of a plant mixture can be determined by inspection as soon as the first batch is mixed and any necessary corrections can readily be made before the mix has been manufactured in quantity. Viewed from any angle, bituminous mixtures for road surface repair and maintenance in a theater of operations present a most valuable addition to methods already familiar to the military engineer.

In civilian construction of all kinds the use of portland cement is almost universal. For military construction in war, however, its use is restricted to circumstances where the element of time between construction and availability for use is not the paramount consideration. The use of portland cement for road and airport surfacing is confined to soil-cement stabilization, portland-cement grout-filled macadam, and the familiar portland-cement concrete-slab pavement. Because of the relatively long time that must elapse between the construction and the availability for use of any of these surfaces, it is not believed that they are adaptable for military use in war except occasionally in rear areas of a theater of operations, and in the zone of the interior. No one has yet developed a portland cement patching and maintenance material suitable for use where traffic must proceed over the surfaces as soon as a repair is made or during its preparation.

Engineer officers responsible for roads in forward areas should not be required to concern themselves with any strictly technical elements of road work. Their problems are all of a purely practical nature. There is no time for detailed analysis during battle. True, the practical solutions of these problems should be based upon sound technical considerations, but the training and resourcefulness of engineer officers and men, plus the *Engineer Field Manual*, with appropriate tables and curves, must serve in war in lieu of the soil laboratories, chemists, and technical experts available to highway engineers in peace time. The military engineer must know within reasonable limits "all means of road construction and maintenance." Engineers from civil life particularly should understand clearly that the road function of the military engineer is "to make passable and keep passable the routes over which our own forces advance and to make impassable the routes over which the enemy may advance." The one best preparation is practice in the field today under closely simulated war conditions with plant, equipment, materials, and engineer troops just as they will be available in war.



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Contamination of Ground-Water Resources

Industrial Wastes Enter Gravels Following Old River Channels in Southern California Coastal Region

By Burt Harmon, M. Am. Soc. C.E.

Hydraulic Engineer, Long Beach Water Department, Long Beach, Calif.

In the arid and semi-arid regions of the West, many large communities are vitally dependent upon ground-water supplies. Flash floods and shifting river channels have complicated the interconnections between water tables in the Los Angeles region. Surveys show that refinery wastes in particular penetrate to considerable distances from sumps and stream beds. Mr. Harmon's paper was originally presented before the Twelfth Annual Institute of Government at the University of Southern California, Los Angeles.

There are many types of industrial waste which, when introduced into an underground water supply, will force its abandonment for domestic use. Among those found along the coastal plains of the Pacific Southwest are greasy wastes, from tanneries, packing plants, woolen mills; oily wastes, from oil wells and refineries, soapy wastes, from laundries; acid wastes, from chemical works and oil refineries; and saline wastes, from oil wells. To this list should be added brewery wastes, which are highly carbonaceous, and wastes from beet-sugar plants, which are high in suspended matter.

Many of these wastes could be, and should be handled through sanitary sewer systems, but for the oily, acid, and saline types the only proper method is the construction of industrial drains discharging into the ocean. While the wastes from oil wells and oil refineries, like most other industrial wastes, are never responsible for water-borne disease, they impart tastes and odors or increase the salinity of the water to the extent of rendering it unfit for domestic, and not infrequently for irrigation, use.

Contamination of a surface stream as a rule is not too difficult to trace. But in the region in question, where stream beds may be totally dry for eight or nine months in the year, the attempt to trace contamination to its source may develop into a problem that, to use army phraseology, "has no approved solution." A brief review of the physical changes that have taken place during historic times may aid us in appreciating this problem, as well as in understanding the dispersion of contamination in underground waters.

The San Gabriel and Los Angeles rivers, as well as most of their tributaries, have their source in the San Gabriel Mountains, which lie about thirty miles from the ocean. The area between the mountains and the sea is divided into a valley section and the coastal plain by a range of sedimentary hills lying from 18 to 20 miles from the ocean. The two rivers are confined in more or less stable channels through the sedimentary hills, but in the coastal plain they have a very migratory character.

At the time of the founding of the City of Los Angeles the Los Angeles River ran parallel to, and a short distance east of, Main Street, turned to the west some distance to the north of Santa Barbara Avenue, flowed through what is now Exposition Park, and entered the Pacific at Ballona, now Playa del Rey. During a flood in 1825, the river cut a new channel southward, passed near the foot of Dominguez Hill, and entered the ocean at San Pedro. The river continued its migratory habits for nearly a century, moving eastward from time to time until it was finally confined by the Flood Control District in what we hope will be a permanent channel (Fig. 1).

Throughout a portion of this same period the San Gabriel River, after leaving Whittier Narrows, flowed south and southwest, passed along the foot of the mesa north of Signal Hill, and discharged through what is now the entrance to Long Beach Harbor. During the flood of 1867–1868, this river, following an irrigation ditch, cut a new channel south to Alamitos Bay—a channel still known to the old residents as New River. At the height of the flood the waters of the Los Angeles, San Gabriel, and Santa Ana rivers covered the coastal plain in a continuous sheet from Dominguez Hill to the mountains east of Santa Ana. In 1889 the San Gabriel above El Monte broke over into the channel of the Rio Hondo. Each successive flood has sent more and more water down that channel, until now more than half the flood flow of the San Gabriel passes west of El Monte and joins the Los Angeles River near Workman Station, below Southgate.

These migrations in historic times illustrate what has been taking place during the entire process of building up the valleys and the coastal plain from material weathered and eroded from the mountains and the sedimentary hills. The coarser and heavier materials were deposited first and the lighter clays and silts were carried into the coastal plain. In these clay and silt deposits subsequent floods cut channels and then filled them with sand and gravel.

These gravel-filled channels are nowhere parallel and may be interconnected laterally. Varying in depth from

A Flood in the Los Angeles River Floodway (January 1, 1934)

LOW FLOOD STAGE ON THE LOS ANGELES RIVER FLOODWAY

a few feet to many hundred feet, they are covered with clay blankets that formerly confined their waters under pressure. The first artesian well drilled in the Long Beach area tapped a channel whose pressure indicated that its intake was in or north of Whittier Narrows. Intakes of the deeper gravels may lie still farther north, while others head between the Narrows and Downey. Only the shallower gravel deposits have their intakes south of Downey. It is obvious that waste waters discharged into the more-or-less dry stream beds or put underground through sumps or other means will eventually percolate into these water-bearing gravels, with the result that they will have a very serious effect on the water supply of the coastal plain.

In 1927 a series of sumps was constructed along the east bank of the Los Angeles County Flood Control Channel about $3^1/_2$ miles from the ocean for the purpose of reclaiming such oil as remained in the waste waters. These sumps handle a daily average of 60,000 bbl, or more than 2,500,000 gal of waste water, which contain approximately 9,000 ppm of chlorine. This corresponds to about 13,000 ppm of sodium chloride. The entire overflow is discharged into the Flood Control Channel. Both the channel and the sumps are unlined and rest on the sandy bottom of the old river channel.

Our attention was called to the possible danger arising from the operation of these sumps when it was reported that privately owned wells on a ranch more than a quarter of a mile west of the channel were becoming too salty to use for irrigation. In 1929 a 900-ft well was drilled to replace one of the contaminated wells, perforating the lower 100 ft and cementing off below the zone of contamination. That well is still producing potable water.

The contamination spread slowly, but not uniformly, on both sides of the channel. In some cases the increase of salinity in wells was gradual and in others very rapid. One well, about one-half mile southwest of the sump, that was reported growing more and salty when first checked, showed:

May 9, 1932	169 ppm chlorine
May 20	199 ppm chlorine
June 10	202 ppm chlorine

Another well about a half mile to the north showed:

January 2, 1933	20 ppm chlorine
February 4	17 ppm chlorine
February 24	384 ppm chlorine
April 22	388 ppm chlorine

Both these wells were abandoned.

In November 1931, the Long Beach Water Department began a survey of the local area that ultimately developed into an investigation of the entire Los Angeles River drainage basin south of the City of Los Angeles. This investigation was begun by locating and mapping all available wells, and included a regular and systematic sampling of water and measurement of water levels. Most of the samples taken were tested merely for chlorine and sulfates. To distinguish between contamination from sea water and oil-well wastes, samples were tested for iodine, the local oil-well wastes being high in this (from 40 to 60 ppm), while sea water carries only a trace. In addition to sampling shallow wells west of the Flood Control Channel, we bored a series of test holes in the bed of the channel itself. These were followed by another series east of the channel spaced with more less regularity between Willow Street and Thirty-Second Street. It was hoped to determine from these latter the extent of percolation from the channel and also that from a small ditch carrying about 1,500 bbl per day of oil-well wastes from city-owned land in the Signal Hill field.

These test holes showed ground water with varying degrees of chloride concentration but of such irregular occurrence that it was hopeless to attempt to trace the source. For example, a series of holes running east from the Flood Control Channel along the south side

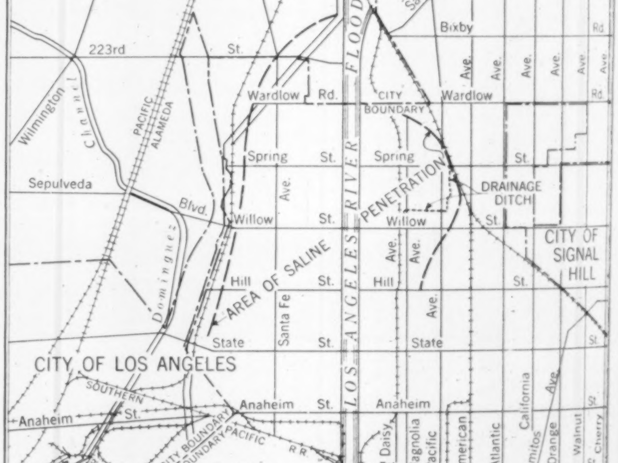

Dominguez St.
Carson Ave.
Carson St.
San Antonio Dr.
Bixby Rd.
223rd St.
Wilmington
Channel
PACIFIC
ALAMEDA
Wardlow Rd.
CITY BOUNDARY
Spring St.
Sepulveda Blvd.
PENETRATION
DRAINAGE DITCH
Willow St.
CITY OF SIGNAL HILL
AREA OF SALINE
Dominguez
Hill St.
Santa Fe Ave.
State St.
LOS ANGELES RIVER FLOOD WAY
CITY OF LOS ANGELES
SOUTHERN PACIFIC R.R.
Anaheim St.
LOS ANGELES CITY BOUNDARY
LONG BEACH CITY BOUNDARY
Daisy
Magnolia
Pacific
American
Atlantic
California
Alamitos
Orange
Walnut
Cherry
7th
4th
T. 4 S.
T. 5 S.
UNION PACIFIC
Cerritos Channel
Turning Basin
Broadway
Ocean Blvd.
Sea Side Blvd.
Rainbow Lagoon
SAN PEDRO BAY

FIG. 1. PORTION OF CITY OF LONG BEACH AND SAN PEDRO BAY Showing Los Angeles River Floodway as Now Stabilized

"Waste-Water" Ditch Carries Saline Flow from Oil Field in Signal Hill Area

Many of These Wastes Found Their Way to the Ground-Water Table

of Spring Street, and spaced 600 ft apart, showed chlorine in amounts of 800, 400, 200, and 6,000 ppm.

These tests did show conclusively, however, that the bottom and sides of an unlined ditch are not sealed by the drilling mud and oil emulsions carried by the waste waters. Holes up to half a block from the open ditch mentioned gave samples that ran from 5,000 to 10,000 ppm of chlorine.

It is not difficult to distinguish between wastes from the operation of oil wells and those from oil refineries, as the former consist mainly of brine, with a salt content running at times as high as 22,000 ppm. The amount of brine in refinery wastes depends on how completely the oil has been dehydrated at the wells. Oil, except in the form of oil emulsions, is not usually found in these wastes, as most refineries are equipped for its complete recovery. The phenols which impart such a pronounced taste and odor seem to be derivatives of the various hydrocarbons. These wastes are usually highly acid. In our survey we confined ourselves to the Los Angeles River, as investigation on the San Gabriel side showed little about which we need concern ourselves. The analysis pointed to the presence of industrial wastes of a different type farther upstream, so the study was carried into the Los Angeles–Vernon–Huntington Park industrial area.

Among the industries discharging wastes into the channel were found chemical works, paper mills, fiberboard plants, a railroad yard, refineries. As all these discharge wastes that are not permitted in sanitary sewers, they use the Los Angeles River channel as an industrial sewer. In the regular sampling of June 1932, the effluent from one plant was found to carry 1,900 ppm of sulfates with no carbonates or chlorides. An adjoining plant was discharging 810 ppm carbonates, 2,530 ppm sulfates, and 1,400 ppm chlorides. It is not difficult to sample and analyze these effluents, but it is impossible to estimate the total amount discharged into the river channel.

While a portion of the solutions that percolate into the loose sands of the channel may be carried to sea by the infrequent floods, our studies in Long Beach show that most of them do not remain in the channel to be washed away but penetrate great distances in all directions. And while they are building up future troubles for the water users to the south, they also present a very live danger to the areas in which they are now being discharged, as will appear for the following reasons.

The major portion of the underground water supply of the coastal plain is furnished by the San Gabriel River. Very little of the underground flow of the Los Angeles River passes the infiltration galleries of the Los Angeles Water Department; practically the only contributions made by this stream, aside from industrial wastes, are flood waters and the drainage from city streets. The cities of the industrial district lying south of and adjacent to the City of Los Angeles have a population of approximately 100,000. The water supply for this area is entirely from deep wells, and is estimated at 12,500,000 gal per day. It is obvious that this supply of water cannot come from the small underground flow of the Los Angeles River.

Monthly measurements of the elevation of the water surface in a large number of wells in the coastal plain have been made for the past eight years. These measurements show that the water plane fed by the San Gabriel River, from Whittier Narrows south to Downey, slopes to the west and northwest as well as south toward Long Beach. This indicates that the waters of the San Gabriel pass underneath the channel of the Los Angeles River to replenish the gravels drawn upon by the wells in the industrial district.

There is no indication that any contamination from the industrial wastes discharged in this area has yet percolated to the underground water supply. In fact, analyses of the water of one of the wells from 1929 to 1939 show that its hardness has progressively decreased over that period. Nevertheless the menace is still there, and should the clay cap that has thus far protected this area be penetrated by the stored-up wastes, the underground gravels would have to be abandoned as a source of water supply.

The procedure followed by the oil companies in the Santa Fe Springs–Whittier–Montebello district for disposal of waste waters points to the logical solution—piping of such wastes to the sea instead of utilization of the stream beds as industrial sewers and of the water-bearing gravels as cesspools.

Summer Flow in Los Angeles River Floodway (October 1, 1934)

This Is the Condition of the Channel During Most of the Year, When Wastes Penetrate Underground Strata

Corrosive Effect of Inorganic Fertilizers on Concrete

By Arthur F. Pillsbury, Assoc. M. Am. Soc. C.E.

Assistant Professor of Irrigation, University of California,
College of Agriculture, Los Angeles, Calif.

APPLICATION of nitrogenous commercial fertilizers through the medium of irrigation water is becoming a common practice in the West because of certain economies of distribution. Usually, the solutions containing the fertilizers are run through concrete pipe lines, and as a result such lines have become corroded and have failed. In other instances no detrimental effect has been noted after ten or more years of this practice.

In 1937 a project was initiated to obtain more rational data on the subject and to evaluate the practical problems involved. The work was done at the University of California's Citrus Experiment Station at Riverside. The general procedure was to utilize sections of standard concrete irrigation pipe as containers for solutions of several different commercial fertilizers using three different concentrations of each. Comparisons were made with similar results from local irrigation water ("canal water"), distilled water, and solutions of sodium sulfate. The latter is considered to be the principal corroding agent of alkali and sea water, and has been used extensively in experiments on corrosion of concrete. Concrete cylinders 2 in. in diameter and 4 in. long were fabricated under uniform conditions and immersed in various solutions. The experiment, so far as exposure to the solutions was concerned, ran for a period of one year. Solutions were renewed weekly for four weeks and monthly thereafter.

Periodically the pipes and cylinders were inspected for any visible corrosion. At the conclusion of the experiment all the cylinders were tested for compressive strength. Differences in absorption characteristics of fragments of pipe immersed in the various solutions were also investigated. Studies were included as to the effect of the concrete on the pH of the solution and vice versa, and as to measures necessary to maintain or obtain a desired pH. Some treatments were devised wherein the concrete was alternately kept dry and subjected to the solutions. Some of the solutions were stirred by bubbling compressed air through them.

Cements used in making the 2 by 4-in. compression cylinders were of known chemical content and fineness, and were of types with widely varying characteristics. Data were therefore procured as to the effect of cement composition on corrosion. Cements have been found to vary considerably in their resistance to sodium sulfate solutions. Table I shows the analyses of those used in our tests.

Commercial fertilizers used in the experiment were ammonia (NH_3) (actually 28% ammonium hydroxide); ammonium sulfate (20.5% N); calcium nitrate (15.5% N); "Calnitro" (20.5% N) (ammonium nitrate with admixture of 35% calcium carbonate); sodium nitrate (16.0% N); and "Ammo-Phos" (16% N, 20% P_2O_5) (a commercial grade of mono-ammonium phosphate). Concentrations were related on the basis of guaranteed nitrogen content.

In the "normal" treatments, the nitrogen concentration (440 ppm) was equivalent to 100 lb of nitrogen (N) in 1 acre-in. of water. This is approximately the concentration that might be obtained in the field where an applicator is used. This assumes a 3-in. irrigation with initial "clear" water to get water through the furrows, and a final thorough flushing to clean all nitrogen solutions from the pipe lines.

Because of work done on corrosion in sodium sulfate solutions, treatments using that chemical in 1 and 5% solutions were also tried. The sulfate ion concentrations of two "accelerated" ammonium sulfate treatments were made equal to the sulfate ion concentrations of the sodium sulfate treatments. Accelerated treatments were used for every other fertilizer with the same nitrogen concentrations. In summarizing data, reference to concentrations can be simplified by using as a unit 100 lb of nitrogen per acre-in. of water. Thus the concentrations become 1 (normal), $4^1/_2$, and $22^1/_2$ units for the various tests.

Table I. Compound Composition (in %) and Specific Surface of Various Cements Used in 2 by 4-In. Concrete Cylinders

Cement	*A*	*B*	*C*	*C*₁	*D*	*E*	*F*	*G*
C_3S	48.11	57.8	46.51	46.39	45.9	45.54	43.72	44.30
C_2S	25.85	20.4	25.98	26.05	27.4	29.5	26.65	41.96
C_3A	9.87	8.10	8.29	7.14	6.4	6.24	4.70	3.94
C_4AF	7.27	7.70	10.2	10.37	13.0	12.7	15.76	4.87
Specific surface:								
Cm² per gm	1,551	1,822	2,057	2,079	1,841	1,980	2,140	2,058

There has been some discussion on the advisability of acidifying alkaline irrigation waters as a means of cor-

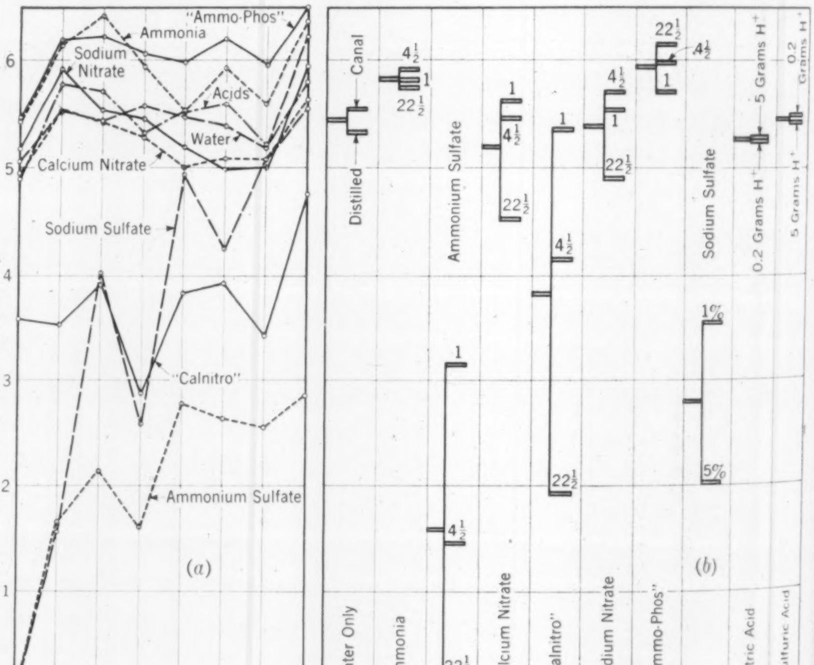


Fig. 1. (*a*) Strengths of 2 by 4-In. Concrete Cylinders, Mixed with Several Cements (Table I), and in Various Solutions; (*b*) Average Strengths of Cylinders in Terms of Concentrations of Solutions, in Units

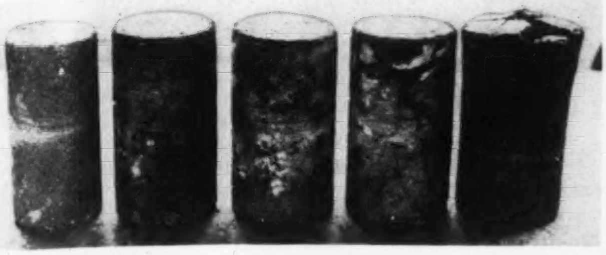


Fig. 2. Typical Cylinders from $4^1/_2$-Unit Ammonium Sulfate Treatment After Year of Exposure
Arranged from Least (Left) to Greatest (Right) Visible Damage

recting a soil pH which is not sufficiently acid. Without forming any opinion as to the merits, for plant use, of a more acid water, it was decided that it would be of value to investigate the effects of acidified water on the concrete pipe, and conversely the effect of the pipe on the pH of the water. Two acids were used—sulfuric because of its low cost and nitric because of its nitrogen content.

Results of the tests are shown graphically in Fig. 1. Cements were labeled *A*, *B*, *C*, and so forth, on the basis of what appeared, from the analyses in Table I, to be their resistance to corrosion by sodium sulfate. That is, *A* appeared to be the most susceptible to corrosion, and *G* the least. Cements *C* and C_1 are of the same brand and of similar analysis, but C_1 was older. In mixing the batches of concrete it was noted that those made with *G* cement were more plastic and of much better workability. Apparently *G* has better lubricating properties, which fact may influence the quality of the concrete.

Some cogent relations are noted. As regards cements:

1. There is no great difference in strength except in sulfate treatments and except for cements *A* and *G*. Cement *A* had higher C_3A content and lower specific surface. Cement *G* had lower C_3A and C_4AF content and the concrete appeared better lubricated.
2. Age of Cement C_1 may account for its greater susceptibility to corrosion than Cement *C*. Except where the concrete has been corroded, there is no apparent difference in cylinder strength with the two cements.
3. Resistance of the various cements to sodium sulfate solutions corresponds quite closely to the resistance that might be expected from their analyses.
4. In ammonium sulfate solutions the cements fell into groups as follows: Cements *D*, *E*, *F*, and *G* in one group with the most resistance; Cements *B*, *C*, and C_1 in one group with lesser resistance; and Cement *A* with least resistance. Most notable differences in the analyses are the higher C_3A content of *A*, *B*, *C*, and C_1, and the lower specific surface of *A*.
5. There is no significant difference in resistance to corrosion of cements in ammonium nitrate (Calnitro) except for C_1 (because of age) and *G* (possibly better lubricated mix).
6. Ammonium sulfate and sodium sulfate alone expanded the concrete.

These observations apply to the cements themselves. Now, with reference to treatments:

1. Ammonium sulfate has the most harmful effects on concrete—as regards both corrosion and expansion. The corrosive effect appears to be in proportion to the concentration of the solutions, and the period of exposure (the latter from visual inspection during the experiments and in comparing treatments wherein cylinders were exposed to solutions during alternate periods with regular treatments). Ammonium sulfate can be used without undue hazard in irrigation water if the following rules are observed: (*a*) a proportioning device must be used to prevent solutions from ever being more concentrated than about 0.2%; (*b*) concrete pipe lines must be flushed with "clean" water after each application; and (*c*) as is customary, the total net time the solutions are in contact with pipe lines may not exceed about one week per year.
2. With equal concentrations of the sulfate ion, sodium sulfate is less harmful than ammonium sulfate, except possibly for Cements *A* and *B*.
3. There appears to be a slight increase in strength of the cylinders stored in ammonia (NH_3) solutions over those in water. This is not in proportion to concentration, and may be the result of storage in tightly capped containers. Ammonia solutions had the highest pH (most alkaline).
4. Cylinders in mono-ammonium phosphate (Ammo-Phos) solutions had slightly higher strength than any others, and the strength increased with concentration. These solutions were the only ones that were always acid (lowest average pH).
5. Concentrations of calcium nitrate and sodium nitrate to the extent of 1 and $4^1/_2$ units did not affect the strength of the cylinders. The $22^1/_2$-unit concentration moderately decreased the strength.
6. A concentration of 1-unit ammonium nitrate (Calnitro) did not affect the strength of the concrete cylinders, but $4^1/_2$- and $22^1/_2$-unit concentrations decreased the strength with all cements. The amount of corrosion is somewhat in proportion to the concentration.
7. Nitric and sulfuric acid, in the amounts added to the solutions, did not affect the strength of the concrete. The surfaces of the cylinders, however, were severely etched with the heavier applications of acid, and etching was apparent with the light applications.
8. There was a slight but not conclusive decrease in strength of cylinders stored in distilled water as compared to canal water.
9. None of the fertilizers tested showed appreciable harm to concrete pipe lines when used in the customary manner, except for ammonium sulfate. The customary manner of usage implies infrequent use (1 to 6 times per year), moderate concentrations (under about 2%), and flushing after each application.

For Fig. 2, cylinders from one treatment were selected at random and arranged in order of their visible degree of corrosion. Beginning at the left, the cements used and the compressive strengths were as follows: *B*, 2,580 lb; *E*, 1,750 lb; *G*, 2,930 lb; and *D*, 1,690 lb. The right-hand cylinder, Cement *A*, had to be handled with extreme care to prevent its falling apart; its life was estimated at 12 months. Several such cylinders were left to dry after the experiment was completed. It is interesting to note that thereafter they regained some strength—making it difficult to break them up by hand. It is apparent that the visual inspection was subject to error.

Finally, certain deductions apply to pH:

1. In general, the pH of the solutions increased when they stood in contact with the concrete for a period of several days to a week. Similar solutions not in contact with concrete did not increase appreciably in pH.
2. Initial pH values for fresh solutions ranged from 4.0 for mono-ammonium phosphate (Ammo-Phos) to 11.4 for ammonia, and solutions of these two chemicals did not change appreciably on contact with the concrete. Canal water increased from 8.2 to 9.1 within a day and then remained about constant. All solutions other than those containing mono-ammonium phosphate were alkaline within a day or so after renewal.
3. Change in pH while water travels through an ordinary farm concrete pipe line is too small to matter.

Construction Features of Shasta Project

Part I. General Layout and Aggregate Production

By Ralph Lowry, M. Am. Soc. C.E.

Construction Engineer, U.S. Bureau of Reclamation, Redding, Calif.

Outstanding among current engineering work is Shasta Dam on the Sacramento River in northern California. This structure, next to the largest of its kind in volume, will have the highest overflow. After dealing with general features, Mr. Lowry covers the many steps required to obtain the finished aggregates. Finally the necessary 10 million tons of proper grade were found in one deposit 10 miles below the dam. An extensive plant cleans and treats 1,500 tons an hour, separating the material into 5 fractions, as here described in detail. Procedures of further handling are reserved for a later article. This paper was originally delivered at the February meeting of the San Francisco Section.

Shasta Dam is the principal feature of the Central Valley Project in California. It is located on the Sacramento River about 12 miles north of Redding and about 6 miles downstream from the confluence of the Pit and Sacramento rivers. The dam is an engineering structure of the first magnitude, being second in height only to Boulder Dam on the Colorado River, and second in mass to Grand Coulee Dam in the State of Washington. When completed, it will have the added distinction of being the highest overflow dam in the world. Its principal dimensions are: height, 560 ft; length across the top, 3,500 ft; base thickness, 580 ft; top width, 35 ft; and mass, 6,000,000 cu yd of concrete. It is founded on a volcanic flow of andesite, deeply weathered. Maximum cuts of 175 ft were required, with removal of 3,000,000 cu yd of material before suitable rock was exposed—that is, suitable to support a structure of this size and importance.

The reservoir that will be created will inundate some 30,000 acres of land and store 4,500,000 acre-ft of water. This will utilize the three principal tributaries—the Sacramento, McCloud, and Pit rivers, backing up the water a distance of from 25 to 40 miles. In addition to the construction of the dam, a great amount of work must be done on supplemental features before the project is complete.

EXTENSIVE RAILROAD RELOCATION REQUIRED

North from Redding, 12 miles below the dam, the main line of the Southern Pacific Railroad between California and Oregon is located along the Sacramento River. It runs past the dam site and through the full length of the reservoir. Above Redding, it has therefore been necessary to relocate 30 miles of railroad, an undertaking which, when complete, will cost in the neighborhood of $19,000,000. The new stretch of railroad has 12 tunnels, all concrete lined, and 7 major bridges.

One bridge, crossing the Pit River arm of the lake, is 3,500 ft long and the upper of its two decks is 500 ft above the river. The lower deck is being built to accommodate double railroad tracks, while the upper will support a 4-lane highway. The bridge is a steel superstructure resting on concrete piers, the highest of which is 360 ft. This structure alone will cost about $5,000,000.

A part of the present Highway No. 99 is within the reservoir site, and is to be replaced by a relocated route 15 miles in length, at an estimated cost of $3,500,000. Other work includes the relocation and construction of roads, trails, telephone, telegraph, and transmission lines; the clearing of 24,000 acres of timber and brush; and the construction of the necessary facilities to salvage the salmon run on the upper Sacramento River.

A major feature of Shasta Dam is the hydroelectric power plant which is being built along with the structure. It is located just downstream from the dam on the right (west) bank of the river. The building will house five units, four to be installed shortly, and a fifth for future installation. Each unit consists of a 103,000-hp vertical turbine directly connected to a 75,000-kva generator, the turbine being served by a 15-ft plate steel welded penstock. Power will be generated at 13,800 v and passed through transformers and a switching station at the dam for transmission at 230,000 v to the San Francisco Bay area. It is understood that this plant, when complete, will have the largest capacity of any hydroelectric plant in California.

General View of Site, Looking South Down Sacramento River

Another important supplemental feature planned for construction in connection with Shasta Dam is the Keswick afterbay dam, located about 8 miles downstream. Its purpose is to eliminate the daily surges which are likely to prevail in the Sacramento River if the fluctuating water releases from the Shasta Power Plant are not regulated. Preliminary studies indicate that Keswick Dam will be built to a height of about 90 ft and will pond some 10,000 acre-ft of water. It is also believed that a power plant of about 75,000-

kw capacity can be justifiably built at that point. This dam and power plant will involve the expenditure of 11 or 12 millions of dollars.

Since Shasta Dam is a concrete structure, the principal item of work in its construction is the manufacture and placement of concrete. One of the main features, the processing of the concrete aggregates, has been selected as the subject of this article. An attempt will be made to describe it in some detail.

LONG SEARCH MADE FOR SUITABLE AGGREGATE DEPOSIT

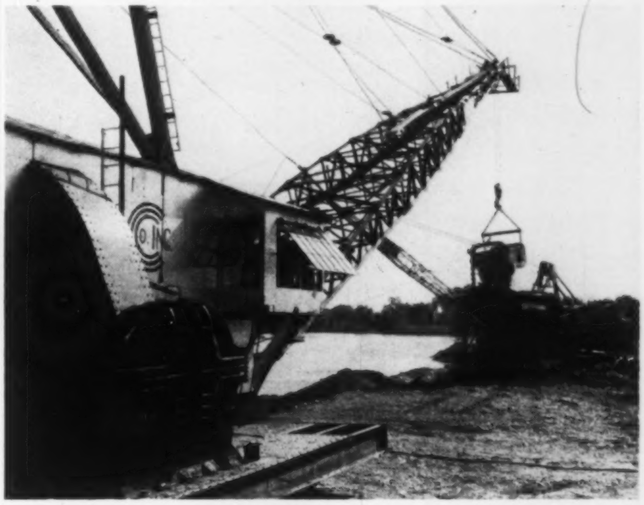
As early as 1935, and continuing for four years, a search was made for a suitable deposit of concrete aggregates for use in the dam. During this period some 60 deposits within a radius of 100 miles from the dam, including sand and gravel as well as rock, were investigated and tested. This investigation consisted of exploring the deposits by pits, shafts, and tunnels, and testing the material for strength, grading, durability, and also for geological and chemical properties and characteristics.

Usually one-eighth of the material removed from the pits was uniformly selected and screened for grading. Representative samples of the screened material were combined in various concrete mixes to provide samples, which were tested in the usual manner for tensile and compressive strengths. Cylinders up to 3 ft in diameter were tested in compression. Other samples were subjected to durability tests including 100 cycles of alternate freezing and thawing, and 5 cycles of the standard sodium sulfate test. Representative samples of the more favorable deposits were subjected to a geological study, including the preparation of thin sections for microscopic examination. Testing was done both in the laboratory at the dam and in the laboratory of the Bureau of Reclamation at Denver.

Pit River Bridge, Combined Railroad and Highway
Steel Erection as Seen from South Abutment

In exploring the deposits, some 450 test pits were dug, varying in depth from a few feet to 30 ft. Ground water encountered above the bottom of the gravel in a few of the more favorable deposits required the extension of drill holes from the shaft bottom to further develop and sample the deposit. Many of the deposits contained considerably less than the 10,000,000 tons of aggregate required for the construction of Shasta Dam. Other deposits were quickly eliminated for failure to meet the durability test, and several of the remaining turned out to be economically not feasible.

In general, it was found that the better gravels were located downstream from the dam along the Sacramento River. Two deposits, the Kutras and the Hatch tracts, which are, respectively 10 and 30 miles downstream from the dam site, were finally selected for contract advertisement. The specifications provided that the 10,000,000 tons of aggregate would be processed and delivered in 5 sizes—sand, pea gravel, intermediate gravel, coarse gravel, and cobbles from 3 to 6 in. in diameter.



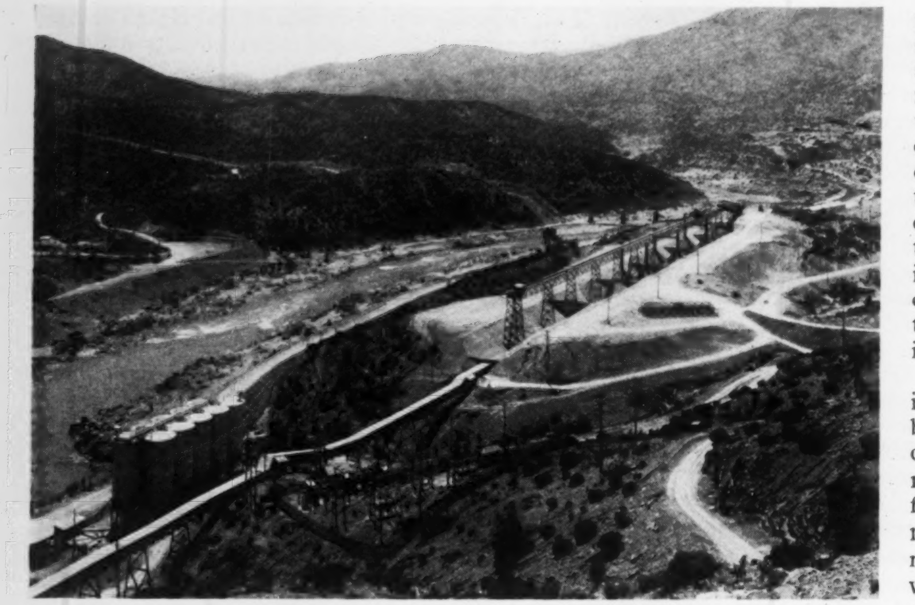
Procuring Aggregate at Redding Gravel Plant
Dragline Deposits Raw Material in Receiving Hopper

It was found that the Kutras sand contained approximately 25% of inferior shaly material which was unsuitable. The specifications therefore required its removal and replacement by satisfactory reduction of suitable gravel fractions. Scrubbing was also required for the Kutras gravel to remove adhered coatings and to break up individual particles where incipient fractures prevailed.

Certain portions of the Hatch tract were known to be deficient in cobbles, and selective development of the deposit was specified, including a provision that the expected cobble deficiency would have to be corrected by additions from other sources. The construction of several miles of expensive railroad was also necessary to reach the Hatch tract.

The Columbia Construction Company, Inc., submitted the low bid and received the contract for processing and delivering aggregates from the Kutras tract. Construction of the processing plant began in mid-summer of 1939, and was rushed to completion so that the initial processed material, which was for railroad work, was delivered in December of the same year. The contract specified that the plant must be capable of producing 22,000 tons of aggregate on peak days and of maintaining a delivery of 500,000 tons per month for several successive months.

Material is excavated from the deposit and loaded onto the pit conveyors by two walking-type draglines of 7 and 10-yd capacities. The larger machine is equipped with a boom 140 ft long. While the excavation to date has been only from 20 to 30 ft deep, it is expected that in some parts of the pit a 50-ft depth will be required, and the contract provides against such a contingency. The material removed overlays undesirable clay, shale, and decomposed deposits of inferior gravel, requiring constant and continuous pit inspection—a difficult task owing to the relatively high water table. Fines in an amount sufficient to give the material a tendency to flow, create problems in placing it and removing it from the stock pile, and in transporting it on steep conveyors.



STORAGE SITE NEAR DAM—COVERED AGGREGATE CONVEYORS TO DAM AND CEMENT SILOS, LEFT; TRESTLE FOR STOCK PILES, RIGHT

Special drawdown gates and ribbed conveyor belting have been recently installed in an attempt to overcome these difficulties.

After being excavated, the raw material is brought to the primary crusher unit by a belt conveyor. There it is first passed over a grizzly, the rejected large boulders being reduced by crushing to a maximum size of 10 in. The resulting product is conveyed to the top of the plant after it has passed through the surge stock pile.

At the plant, the raw feed is taken to a set of screens where it is subjected to scrubbing by high-pressure water sprays under a pressure of 150 lb per sq in. Here the sand is removed and washed into an 8 by 11-ft ball mill, which pulverizes the unsound particles. Gold is recovered by passing the product from the ball mill over jiggs owned and operated jointly by the contractor and the owner of the deposit. After passing over the gold jiggs, the sand fraction is transported to a hydro separator where some of the water, silt, and pulverized sand are wasted over a weir.

After being drawn from the bottom of the hydro separator, the remaining sand is introduced into the first rake classifier, which removes the coarsest particles and rejects the water and finer sand portion for treatment by a second, and then by a third classifier. Since each classifier removes the coarsest portion it receives, the sand is conveniently graded into three specified sizes, which are stock-piled for drainage and later for recombining in the proper proportions for the fineness modulus predetermined as the most suitable. The proportioning is accomplished by automatic feeders drawing material from the three sand fraction piles and discharging onto a common conveyor belt, which terminates with a distributing tripper. The tripper uniformly blends the resulting sand product as it shuttles continuously along portions of a trestle 320 ft long and 60 ft high, maintaining a stock pile of considerable size for additional drainage and subsequent delivery to the dam.

Mention has been made of the screens at the top of the plant. These reject cobbles larger than 6 in. and direct them to a gyratory crusher for reduction. The gravel, after receiving the initial washing, is run through an 8 by 30-ft trommel scrubber after which it is conveyed by belt to the screening tower for final separation and stock piling. Rubber mounted, vibrating screens with square mesh are used. The stock piles are alined over a common reclaiming conveyor tunnel through which the finished product is delivered onto the belt for transportation to the dam. This reclaiming tunnel also contains a return conveyor, which carries either surplus or rejected gravel back to the plant to be crushed or milled into sand. Two crushers in a closed circuit with a screen reduce this gravel to less than $^3/_8$ in. in size, after which it is stock-piled for the mill.

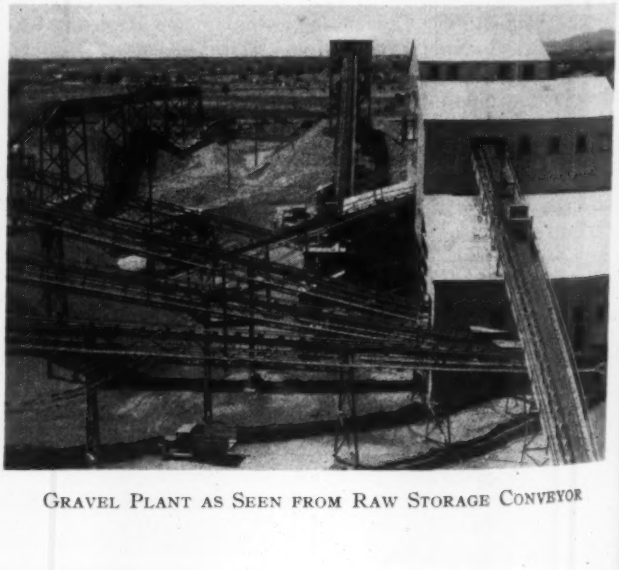
This stock pile of finely crushed rock is placed near the coarse pile of unblended sand, so that either material can be drawn into the 8 by 12-ft rod mill for the manufacture of sand or finer sand as the case may be. All manufactured sand is discharged directly into the flow of natural sand to be washed and classified. The grading of manufactured sand is controlled by the rate of charging the rod mill with aggregate and water. The milling capacity varies between 50 and 100 tons per hour.

Wash water from the various screening and scrubbing operations is all sent to a dewatering rake which salvages the sand and sends it back to the raw stock pile. Thus there is no waste from the plant except the water and the undesirable silt and pulverized sand.

Considering the plant as a whole, it receives raw material at a rate of about 1,500 tons per hour, removes the unsound sand, scrubs the gravel, and grades the aggregate into 4 gravel sizes and 3 sand sizes, then reblends the sand in the required proportions. An air blower also removes some of the roots and similar material from the aggregate.

It was originally intended to deliver the aggregate to the dam by rail but the contractor was later given an extra work order to deliver it by belt conveyor at an appreciable saving to the government. The handling of material until it reaches its destined place in the dam as finished concrete is a major subject in itself. It will be treated in a subsequent paper.

Shasta Dam, as one of the key units of the great Central Valley Project, is being built by the Bureau of Reclamation, U.S. Department of the Interior. The writer is Construction Engineer.



GRAVEL PLANT AS SEEN FROM RAW STORAGE CONVEYOR

Municipal Transportation

Problems Solved by Probability Studies Applied to Census and to Use Data

By Ernest P. Goodrich, M. Am. Soc. C.E.
Consulting Engineer, New York, N.Y.

FINDING laws for, or setting limits to, such difficult factors as population, transit patrons, or riding habits as applied to growing cities seems well nigh an impossible task. But Mr. Goodrich analyzes a large mass of data to prove that it can be done. Sometimes the results are no different from what might be expected according to general principles of probability. The practical aspects are illustrated by studies and traffic plans for the city of Cincinnati, Ohio. This paper was read before a general session of the Society's Fall Meeting in that city.

In the title of this article, the word transportation is used to include the operation of the three kinds of street use technically differentiated as "traffic," "transit," and "transportation." Transportation implies an interurban and long-distance characteristic; transit is local mass movement under more or less consolidated management; and traffic takes in the remainder, involving miscellaneous ownerships and numerous varieties of vehicles.

Transportation affects urban conditions relatively little and involves primarily only local terminals and through routes in the cities. However, when the street traffic is congested, transportation vehicles using the streets do affect conditions adversely in the net result. In New York City moves have lately been made to prevent the inauguration of new interstate bus routes which would pass through congested areas, and even to require the removal of existing routes and terminals to locations outside such areas. In a recent decision, the Interstate Commerce Commission acknowledged the paramount right of the New York Police Department to regulate interstate bus routes and terminal locations within the area under its jurisdiction. All cities should possess comparable authority and take similar action. Planning commissions and traffic, pavement, and terminal engineers should have such possibilities in mind.

Urban transit as a social phenomenon seems to have become so consistent in many of its elements as to make possible the formulation of several dynamic laws with reference to it:

1. As between communities of increasing size, the transit riding habit seems to increase as 1.162 times the 1.374 power of the population. On this relationship the straight locus line in Fig. 1 is based. These data were obtained from the U.S. Census and from Bulletin 496 of the American Transit Association and apply almost exclusively to the years 1926–1935.

2. In any selected community this riding habit has, in the past, increased approximately as the second power of the population. This was true of New York City, as shown by the extension of its graph in Fig. 1, and also of other municipalities not shown. These cities seem to be normal cities in the light of the previously mentioned studies.

3. A variety of special factors affect the riding habit in any selected community to a greater or less degree. Among these factors are: local conditions of topography; the kind, distribution, and density of population; changing economic conditions; factors of management such as fares and the type of service rendered; and such social factors as the now obsolete interurban line, and the advent and degree of use of the automobile. For example, Fig. 2 shows the actual effects of several of these factors as analyzed by Charles A. Stephenson, statistician with the American Transit Association, through whose courtesy the data have been made available. According to his studies of many communities by methods of multiple correlation analysis, the dominant factors which affect riding habit are five in number and may be divided into three groups:

1. Factors Within Company Control
    - (*a*) Average level of fares
    - (*b*) Service standard—vehicle miles operated

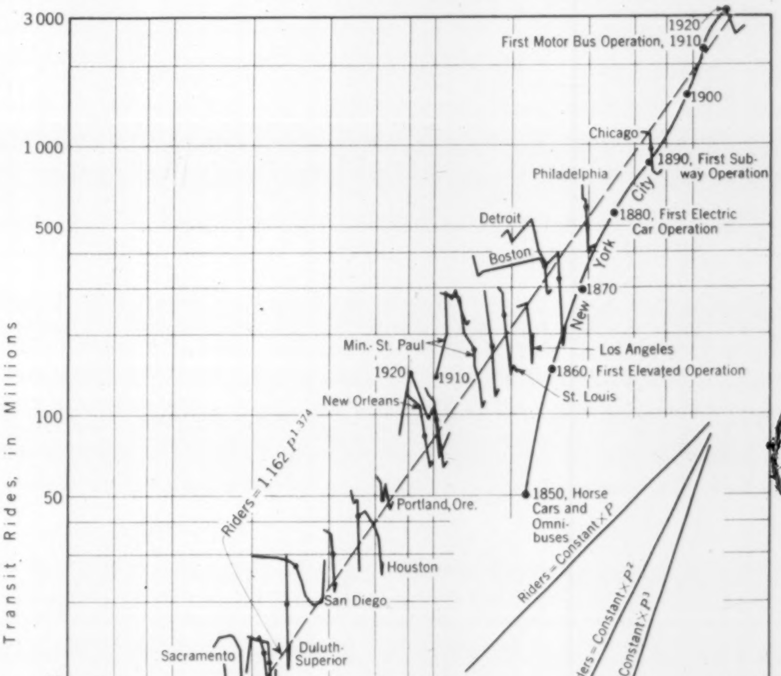


Fig. 1. Variations in Transit Riding Habits

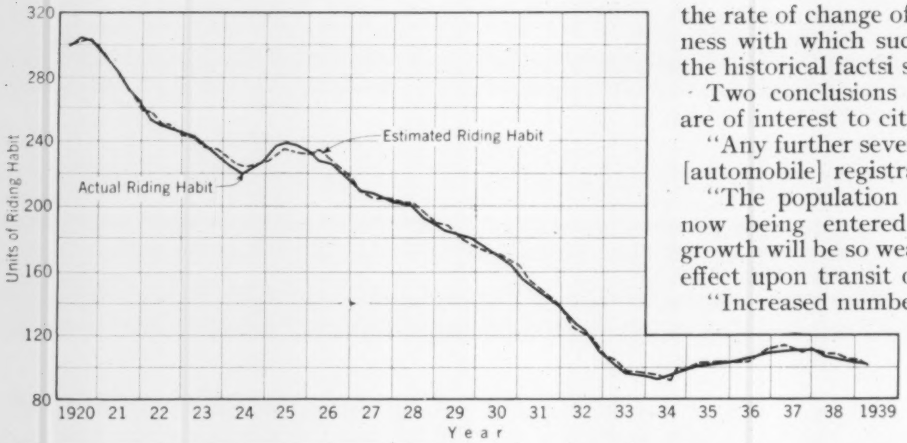


FIG. 2. (ABOVE) EFFECT ON RIDING HABIT OF CHANGES IN ECONOMIC AND OTHER FACTORS

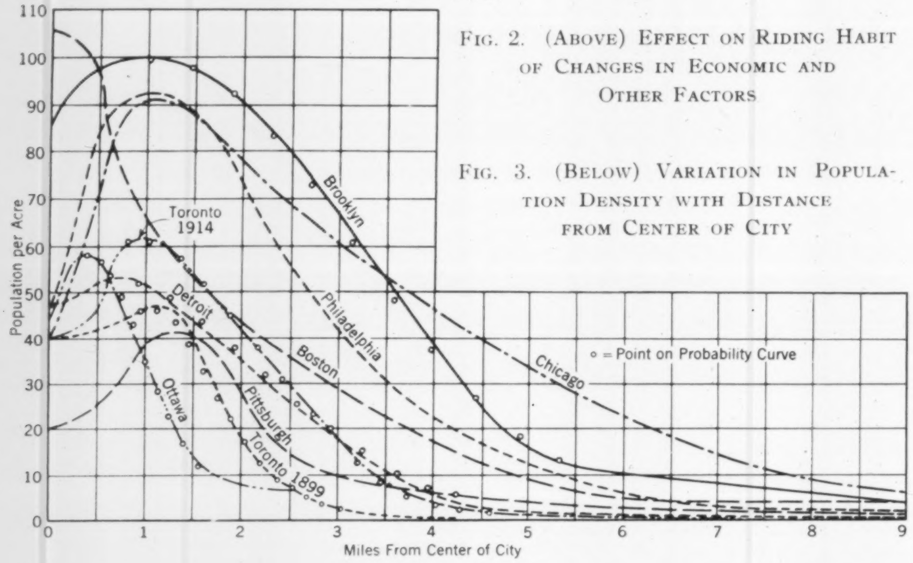


FIG. 3. (BELOW) VARIATION IN POPULATION DENSITY WITH DISTANCE FROM CENTER OF CITY

2. Factors of an Economic Nature
    - (a) Purchasing power, represented by bank debits per capita
    - (b) Rate of change in purchasing power
3. Competitive Factor
    - (a) Automobile registrations

Several of these individual factors have been combined into compound factors for greater precision.

His general formula shows that the computed riding habit is the summation of functions of the vehicle miles operated, of the per capita bank debits divided by the average fare level, of the persons per registered automobile divided by the per capita bank debits, and of the rate of change of per capita bank debits. The closeness with which such empirically determined curves fit the historical factsi s shown by the curves in Fig. 2.

TABLE I. NUMBERS OF COMMUNITIES OF GROUPED SIZES COMPARED WITH CHANCES OF DRAWING SEQUENCES OF DIFFERENT DIMENSIONS

POPULATION GROUPS		NUMBER OF INCORPORATED PLACES IN GROUP	SIZE OF SEQUENCE	CHANCES OF SECURING SEQUENCE OF SIZE GIVEN IN 2,787 THROWS
Lower Limit	Upper Limit			
2,500	5,000	1,320	1	1,393
5,000	10,000	721	2	697
10,000	20,000	388	3	348
20,000	40,000	174	4	174
40,000	80,000	98	5	87
80,000	160,000	45	6	44
160,000	320,000	22	7	22
320,000	640,000	11	8	11
640,000	1,280,000	5	9	5
1,280,000	2,560,000	2	10	3
2,560,000	5,120,000	0	11	1
5,120,000	10,240,000	1	12	0
Total	....	2,787	..	2,787

Two conclusions reached by Mr. Stephenson which are of interest to city planning engineers are that:

"Any further severe permanent losses due to increasing [automobile] registrations are most unlikely."

"The population trend . . . indicates that an era is now being entered wherein the force of population growth will be so weakened as to have a decided damping effect upon transit operations."

"Increased number of purchases as distinguished from increased number of purchasers should be given careful [sales] attention."

Because the total riding habit—in trolley, bus, and private automobile—will be almost certain to increase at least as fast as the population, this fundamental social factor deserves careful study as to its probable future amount in specific communities and states, and in the continental United States as a whole. Consequently, the results of certain population investigations are believed pertinent.

Research seems to show that population groups are automatically formed in accordance with that law of pure chance which applies to the repetitive flips of a coin in so far as the numbers in groups of varying size are concerned, and that the same law has held for a hundred years in this country. As far as known, this law was first pointed out in my paper presented before the American Sociological Congress in New York in 1926, for which presentation some of the data used herein were prepared, for example Tables I and II.

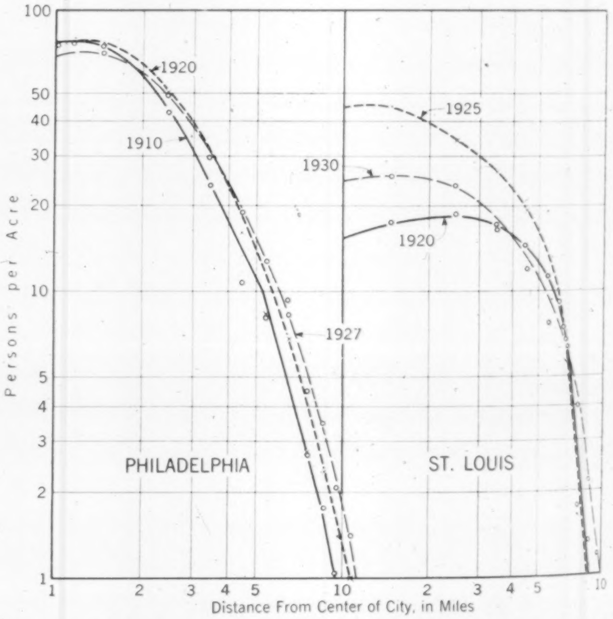


FIG. 4. VARIATION IN POPULATION DENSITY FOR PHILADELPHIA AND ST. LOUIS, SHOWING EFFECT OF INCREASING USE OF AUTOMOBILES

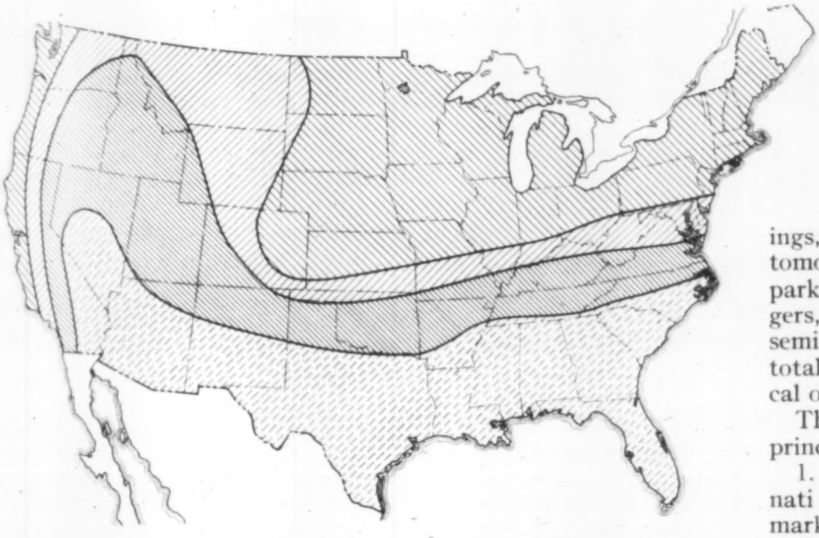


Fig. 5. Distribution of Climatic Energy in the United States, from Highest (Northeast and Far West) to Lowest (South)

Reproduced from *Economic and Social Geography*, by Ellsworth Huntington, Frank E. Williams, and Samuel van Valkenburg, John Wiley and Sons, Inc., New York, 1933

It also seems certain that the variations in average density of population distribution in many cities in the past correspond rather closely with pure chance. In this case, near urban centers, chance would indicate a distribution like that of shots on a target, and the inverse distance law would operate outside such centers. Actual and probability data for various cities are shown in Fig. 3.

It is probable that the use of the automobile may have modified the densities of the outlying rings of most cities so as to increase the populations in them above that indicated by the theory of probabilities (as to shots on a target), shifting to a density varying inversely with distance from a central core, but having a smaller density limit inside that core. This fact, as exemplified by Philadelphia and St. Louis, is shown in Fig. 4. Curves for other cities show that the interurban electric railroad had some such effect in its day. Incidentally that same law of inverse variations seems to have applied to the number of persons per automobile, measured from a given date, and with an asymptotic saturation of ownership.

It should be pointed out that practically all growth curves have a typical shape, whether they apply to chemical reactions, fruit flies in a bottle, yeast cells, or human beings. Furthermore, the same is true of many human social factors, such as the use of vehicles. Turning to other factors which affect distribution, climate seems to be a dominant one, at least in the United States (Fig. 5). Concentration of urban population follows the climatic pattern almost uncannily. The maps which correlate population distribution and climate also show that topography—proximity to waterways, for example—is also effective. Many other correspondences could be cited.

Some of the methods employed to estimate future populations and their application to municipal transit planning are most easily described by reference to studies made for Cincinnati, Ohio. Because excellent mathematical correlations were found to exist between total populations and all traffic, transit, and transportation measures, an intensive study was made of the past, present, and probable future population of the city. In addition to all governmental data, statistics as to persons of school age, industrial employment, newspaper circulation, telephone subscribers, bank clearings, water connections, building permits, automobile registrations, street traffic counts, parking counts, street car and bus passengers, new business branches established each semi-decade, were all carefully analyzed as to totals, and as far as possible as to geographical origins.

This study led to certain conclusions, the principal ones being that:

1. The 1930 population figure for Cincinnati showed an erratic departure from a remarkably consistent previous growth.
2. The 1940 population would show only a small percentage of increase. (The estimated total was only $1^1/_2\%$ too high—460,000 against an actual 452,852.)
3. Decentralization in population was so great during the 1920–1930 decade as to considerably depopulate the central area, and business grew even more rapidly in the suburbs.
4. The considerable expenditures for civic improvements which had been made were so largely outside the central business district that an unbalanced condition had been created, to the detriment of the whole city, but particularly of the commercial center.
5. Traffic was so great at times and at certain points in the business district as to cause delays and annoyance to both automobile users and mass transit riders; yet such traffic had shown no growth for over a decade.
6. If the city as a whole was to prosper, the business district would have to be improved both in traffic efficiency and in appearance.

The traffic and transit facilities were given intensive study, especially in the downtown area. After considera-

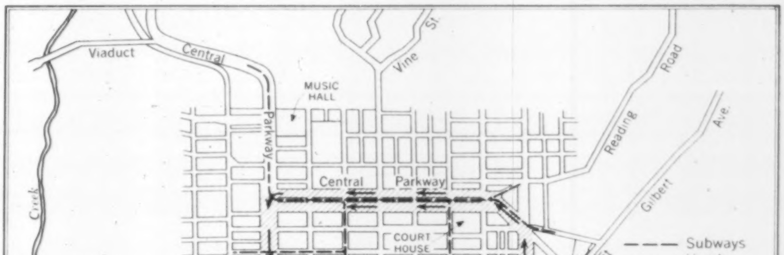


Fig. 6. Proposed Layout for Cincinnati's Central Traffic District

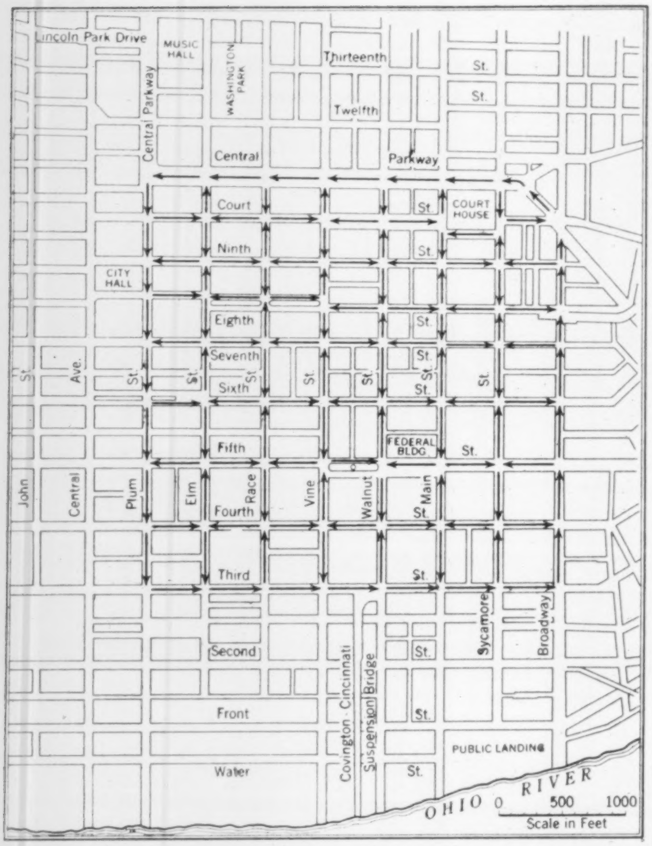


FIG. 7. SOLUTION FOR LOCAL TRAFFIC INSIDE CINCINNATI'S CENTRAL DISTRICT

tion of such possible alternative projects as the underground operation of private automobiles, elevated railroads over streets or in centers of blocks, major street widenings, partial subway facilities for transit operation, and a complete downtown subway loop system for all mass transit, the latter was found to be by far the best solution. Incidentally, the use of this device would automatically make use of the uncompleted subway initiated many years ago. In fact its largely amortized existence was a factor in the final decision. The route of the subway loop is shown in Fig. 6.

As a correlated part of the complete plan for downtown traffic improvement, a belt boulevard of header streets around the downtown area was recommended. It should be operated as a one-way system (counter clockwise) for the detouring of all through traffic and to provide a route by which a vehicle could reach the point nearest to its destination within, before entering the "congested" area.

The streets of the inner zone should be made purely one-directional, alternately, and with a modified signal timing. The practicability of the latter arrangement was analyzed analytically, graphically, and by a three-dimensional model. A scheme to do away entirely with all traffic lights and to permit absolutely continuous vehicle operation at all times, subject to pedestrian crossings, was devised, but I felt it was too radical even for submission in the report. In Fig. 7 is shown the operation of such a traffic system as applied to the Cincinnati Central Traffic District.

If the proposed subway loop is built, and if subsurface sidewalks along both sides of the structure are included, Cincinnati will possess the most complete and efficient traffic and transit system of any city in the country, if not in the world. It is believed that the transportation principles here described can as logically be applied to the problems that harass other municipalities.

TABLE II. NUMBERS OF AMERICAN COMMUNITIES IN TWO LOWEST-SIZE GROUPS FOR FOUR DECADES COMPARED WITH CHANCES OF DRAWING SEQUENCES OF CORRESPONDING DIMENSIONS

(a) *Number Indicated by Actual Count*

CENSUS DATE	TOTAL NUMBER OF COMMUNITIES OF 2,5C0 AND OVER	NUMBER OF COMMUNITIES: Between 2,500 and 5,000	NUMBER OF COMMUNITIES: Between 5,000 and 10,000	NUMBER OF COMMUNITIES: Total Between 2,500 and 10,000
1920	2,787	1,320	721	2,041
1910	2,313	1,106	621	1,727
1900	1,801	893	468	1,361
1890	1,429	726	339	1,065

(b) *Number Indicated by Chance*

CENSUS DATE	TOTAL THROWS	NUMBER OF SEQUENCES IN TOTAL NUMBER OF THROWS IN SEQUENCES OF 1	NUMBER OF SEQUENCES IN TOTAL NUMBER OF THROWS IN SEQUENCES OF 2	TOTAL OF SEQUENCES 1 AND 2
1920	2,787	1,393	696	2,089
1910	2,313	1,156	578	1,734
1900	1,801	900	450	1,350
1890	1,429	714	357	1,071

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Velocity Distribution in Open Channels

By VITO A. VANONI, ASSOC. M. AM. SOC. C.E.

PROJECT SUPERVISOR, COOPERATIVE LABORATORY, SOIL CONSERVATION SERVICE, CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CALIF.

THE von Kármán universal logarithmic velocity distribution law for pipes is

$$\frac{V - V_{\max}}{\sqrt{\frac{\tau_0}{\rho}}} = \frac{2.3}{k} \log_{10} \frac{y}{r_0} \quad \ldots\ldots\ldots (1)$$

where V is the velocity at a radial distance y from the wall; $V_{\max}$ is the maximum velocity in the cross section, that is, the velocity at the center; τ_0 is the friction or shear stress at the wall; ρ is the mass density of the fluid; k is a universal constant having a value of 0.4; r_0 is the radius of the pipe, and 2.3 is merely the factor for conversion from common to natural logarithms

For the case of uniform two-dimensional open-channel flow the above equation becomes

$$\frac{V - V_{\max}}{\sqrt{gdS}} = \frac{2.3}{k} \log_{10} \frac{y}{d} \quad \ldots\ldots\ldots (2)$$

where d is the depth of the flow, S the slope of the channel, and g the acceleration of gravity. Equation 2 can be solved for V, the velocity at any level, which in turn can be integrated over the depth to give the discharge per unit width. This quantity divided by the depth, d, gives the average velocity,

$$\overline{V} = V_{\max} + \frac{2.3}{k} \sqrt{gdS}\, \frac{1}{d} \int_{\delta}^{d} \log \frac{y}{d} dy \ldots (3)$$

where δ, the lower limit of integration, is taken as a small distance from the bottom. Performing the integration in Eq. 3 and noting that the lower limit of the integral vanishes as δ approaches zero gives,

$$\overline{V} = V_{\max} - \frac{1}{k} \sqrt{gdS} \ldots\ldots\ldots\ldots (4)$$

Eliminating $V_{\max}$ between Eqs. 2 and 4, and rearranging, gives

$$V = \overline{V} + \frac{1}{k} \sqrt{gdS} \left(1 + 2.3 \log_{10} \frac{y}{d}\right) \ldots (5)$$

which expresses the distribution law in terms of $\overline{V}$ instead of $V_{\max}$.

The location of the point at which the velocity is equal to the average is found by substituting $\overline{V}$ of Eq. 4 for V in Eq. 2, with the result that

$$y_a = \frac{d}{e} = 0.368\, d \ldots\ldots\ldots\ldots\ldots (6)$$

where y_a, in precise language, is the distance from the channel bottom to the filament moving with a velocity, V, equal to the average for the profile section, and e is the base of the natural logarithms. The depth to this filament measured from the stream surface is then $d - y_a = 0.632\, d$. The above result states that the depth to the average velocity is always the same fraction of the depth of the flow, that is, $0.632\, d$. This result is valid as long as the velocity distribution is logarithmic in form and is not affected by the values of $\sqrt{gdS}$ or k in Eq. 2, or by other factors such as the channel roughness. For instance the result would not be changed by varying k, provided that in doing so the velocity distribution was not altered from the logarithmic form.

Figure 1 shows rectangular and semi-logarithmic plots of velocity profile measurements made on the center line of a rectangular flume 2.77 ft wide, with uniform flow 0.59 ft deep. The measured values are represented by circles while the solid lines represent Eq. 2. Since the velocity distribution follows Eq. 2, the velocity at $0.632\, d$ from the surface is equal to the average for the profile section.

Experience in stream gaging has shown that the velocity at a depth of $0.6\, d$ from the surface is a good approximation of the average for the profile section. From data on 476 measurements in rivers, Hoyt and Grover (*River Discharge*, Wiley and Sons, 1912) obtained a mean value of $0.62\, d$ for the depth to the average velocity. It has also been found that the mean of the velocities at $0.2\, d$ and $0.8\, d$ gives a good approximation of the average. For logarithmic distribution the depth to the average velocity is $0.632\, d$ instead of $0.6\, d$, while the average of the velocities at $0.2\, d$ and $0.8\, d$ is exactly equal to that at depth $0.6\, d$. The latter relationship may be seen from Fig. 1 (*b*) or derived from Eq. 2.

The fact that in streams the maximum velocity does not occur at the surface precludes the possibility that the velocity distribution is strictly logarithmic. However, the relations that have been discussed indicate a striking similarity between observed distributions and those following the logarithmic law, and offer reasonable justification for the use of this law in calculating some of the performance characteristics of natural streams.

Relations similar to those developed for two-dimensional channels can also be derived for circular pipes. Bakhmeteff (*The Mechanics of Turbulent Flow*, Princeton University Press, 1936) obtained the relationship

$$\frac{V_{\max} - \overline{V}}{\sqrt{\tau_0/\rho}} = \frac{3}{2}\,\frac{1}{k} \quad \ldots\ldots\ldots\ldots (7)$$

in which $\overline{V}$ is now the average velocity in the pipe.

Substituting $\overline{V}$ from Eq. 7 for V in Eq. 1 gives

$$y_a = r_0 e^{-3/2} = 0.223\, r_0 \ldots\ldots\ldots\ldots (8a)$$

or

$$r_a = r_0 - y_a = 0.777\, r_0 \ldots\ldots\ldots\ldots (8b)$$

where y_a is the radial distance from the pipe wall to the point where the local velocity has the same value as the average for the entire cross section, and r_a is the distance from the center to the same point. Exhaustive experiments with flow in pipes have shown that the velocity distribution follows the logarithmic law but the relationship expressed in Eq. 8 has not been pointed out.

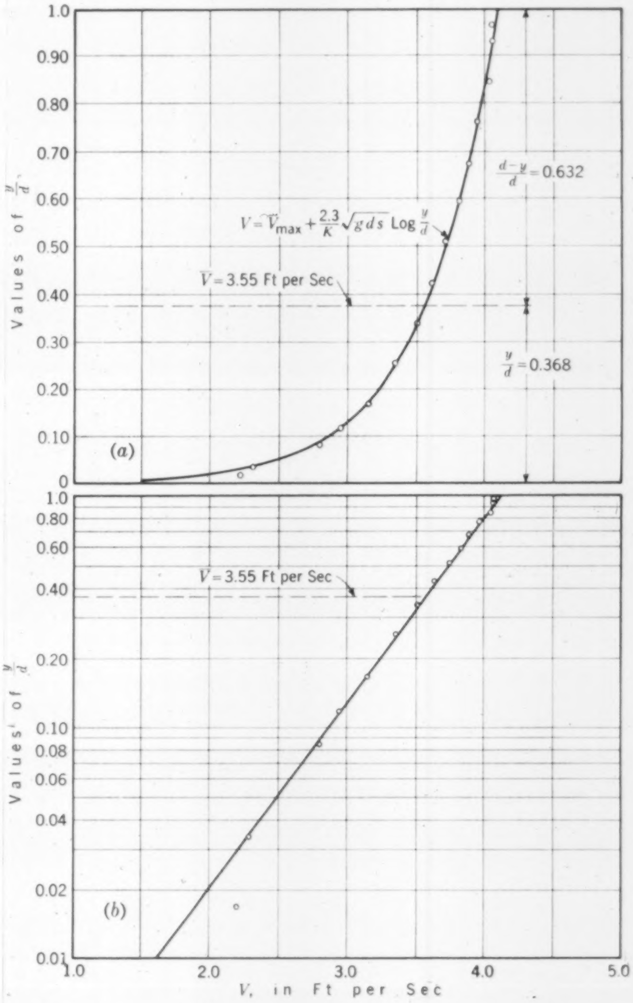


Fig. 1. Velocity Profile at Center of a Flume 2.77 Ft Wide for a Flow 0.59 Ft Deep

Stability of Spillway Channel Side Walls

By STANLEY BENSCOTER, JUN. AM. SOC. C.E.
ASSISTANT ENGINEER, U.S. ENGINEER OFFICE, VICKSBURG, MISS.

SPILLWAY channels are commonly designed to have a joint between the slab and the side wall at a short distance from the face of the side wall (Fig. 1). The joint is commonly designed to be capable of transferring shear, but not moment, through the use of either steel dowels or a key in the concrete. The side wall is investigated for stability by applying the three equations of equilibrium to determine reactions. The shearing force acting at the joint between side-wall toe and channel base-slab is usually neglected, and the resultant determined on this basis is kept within the middle third of the base.

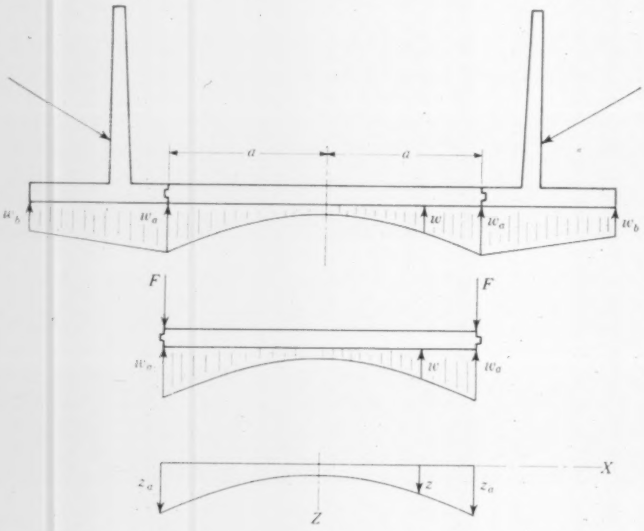


FIG. 1. SECTION OF SPILLWAY CHANNEL AND LOADING

The purpose of this article is to develop a reasonable formula for evaluating this neglected shear force so that it may be brought into the stability analysis of the side wall. A formula for bending moments in the channel slab is also obtained.

The following notation is used:

a = half slab width
E' = modulus of elasticity of concrete
E = $E'/(1 - \mu^2)$, modified modulus of elasticity
I = moment of inertia of slab per unit of width
k = foundation modulus
M = bending moment
V = shear
w = reaction pressure at any point
w_a = toe pressure of side wall
w_b = heel pressure of side wall
x = horizontal coordinate
z = vertical displacement of slab caused by load
z_a = vertical displacement at $x = a$
α = a/λ, an angle
λ = $\sqrt[4]{4EI/k}$, a length
μ = Poisson's ratio
ϕ = a convenient function, see Eq. 16 and Fig. 2

Vertical displacements of the slab are governed by the following differential equation,

$$\frac{d^4z}{dx^4} = \frac{w}{EI} \quad \text{(1)}$$

Let us make the assumption that the displacement at any point is proportional to the reaction pressure at that point. This assumption leads to a reasonable shape for the pressure and displacement diagrams and is expressed by

$$w = -kz \quad \text{(2)}$$

Substituting Eq. 2 in Eq. 1,

$$\frac{d^4z}{dx^4} + \frac{k}{EI}z = 0 \quad \text{(3)}$$

Introducing the fundamental length λ, for convenience

$$\lambda = \sqrt[4]{\frac{4EI}{k}} \quad \text{(4)}$$

The differential equation becomes,

$$\frac{d^4z}{dx^4} + \frac{4}{\lambda^4}z = 0 \quad \text{(5)}$$

The solution of this equation may be written in the following form,

$$z = A \sin x/\lambda \sinh x/\lambda + B \cos x/\lambda \cosh x/\lambda + C \sin x/\lambda \cosh x/\lambda + D \cos x/\lambda \sinh x/\lambda \quad \text{(6)}$$

The four constants of integration must be evaluated through a consideration of the boundary conditions. Because of the symmetry of the structure and the loading system, we may set the coefficients of the unsymmetrical terms equal to zero:

$$C = D = 0 \quad \text{(7)}$$

The boundary conditions are,

$$\text{at } x = \pm a,\ M = 0 \text{ and } V = -F \quad \text{(8)}$$

This gives us the following requirements to be imposed upon the derivatives of z,

$$\left[\frac{d^2z}{dx^2}\right]_{x=a} = 0, \text{ and } \left[\frac{d^3z}{dx^3}\right]_{x=a} = \frac{-F}{EI} \quad \text{(9)}$$

Differentiating z and substituting in Eqs. 9, leads to

$$A = \frac{F\lambda^3}{EI}\,\frac{\sin\alpha \sinh\alpha}{\sin 2\alpha + \sinh 2\alpha} \quad \text{(10)}$$

$$B = \frac{F\lambda^3}{EI}\,\frac{\cos\alpha \cosh\alpha}{\sin 2\alpha + \sinh 2\alpha} \quad \text{(11)}$$

The formula for z becomes

$$z = \frac{F\lambda^3}{EI\,(\sin 2\alpha + \sinh 2\alpha)}\left(\sin\alpha \sinh\alpha \sin\frac{x}{\lambda}\sinh\frac{x}{\lambda} + \cos\alpha\cosh\alpha\cos\frac{x}{\lambda}\cosh\frac{x}{\lambda}\right) \quad \text{(12)}$$

The formula for bending moment becomes,

$$M = EI\frac{d^2z}{dx^2} = \frac{2F\lambda}{(\sin 2\alpha + \sinh 2\alpha)}\left(\sin\alpha\sinh\alpha\cos\frac{x}{\lambda}\cosh\frac{x}{\lambda} - \cos\alpha\cosh\alpha\sin\frac{x}{\lambda}\sinh\frac{x}{\lambda}\right) \quad \text{(13)}$$

Using Eqs. 2 and 4 we may write,

$$w_a = -kz_a = -\frac{kF\lambda^3}{EI}\left(\frac{\sin^2\alpha\sinh^2\alpha + \cos^2\alpha\cosh^2\alpha}{\sin 2\alpha + \sinh 2\alpha}\right) \quad \text{(14)}$$

$$F = -\phi\lambda w_a \quad \text{(15)}$$

where $$\phi = \frac{1}{2}\left(\frac{\sin 2\alpha + \sinh 2\alpha}{\cos 2\alpha + \cosh 2\alpha}\right) \quad \ldots\ldots\ldots\ldots (16)$$

The function ϕ is represented graphically in Fig. 2.

The shear force F is given by Eq. 15 in terms of the toe pressure w_a. The vertical component of reaction on the side wall can now be completely expressed in terms of the two pressures w_a and w_b. These may in turn be computed by applying to the side wall the two equations of equilibrium, $\Sigma V = 0$ and $\Sigma M = 0$.

Application of the foregoing equations is entirely dependent upon an evaluation of the foundation modulus k. This calls for measurements of vertical displacements and soil pressures at various points beneath the slabs of actual structures. Accompanying measurements of compressive strains in the bottom of the slab and tensile strains in the top steel would add much to the value of such a study. However, some approximations are available. H. M. Westergaard, M. Am. Soc. C.E., has presented discussions of this modulus in various studies of stresses in highway pavement slabs (*Public Roads*, April 1926, p. 25; June 1929, p. 65; Dec. 1933, p. 185; also "Stresses in Concrete Runways of Airports," *Proceedings Highway Research Board*, Dec. 1939, p. 197, and reprinted by Harvard University, Graduate School of Engineering, Reprint No. 282). For the present, the value of k = 100 lb per cu in. may be adequate for designing channels like the one discussed. This value is only satisfactory for channels resting on soil—not shale or rock.

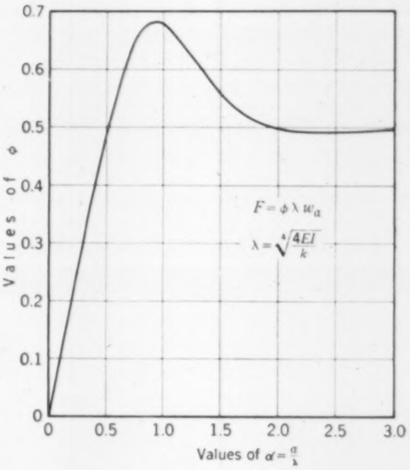


FIG. 2. THE SHEAR COEFFICIENT, ϕ

Taking account of this shear force at the toe of a spillway channel side wall will result in a reduction of required base width and a consequent saving of steel, concrete, excavation, and backfill.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

The Engineer's Role in Planning for the Future

TO THE EDITOR: The role of the engineer in "The Defense Challenge" is well presented by Colonel Bres in the March issue of CIVIL ENGINEERING. There is, however, one job for the engineer, which appears to me to be just as essential and important to the welfare of future society as the actual task of winning the war on the fighting and industrial fronts. Certainly, at the present moment this job may not be as pressing as is the task of producing planes and guns but, if neglected, it can easily mean the collapse of the social order for which we are fighting.

This job is the planning of ways and means to carry on after the smoke and fire of conflict clear away. To meet and defeat the recession that will follow the war will require the services of many engineers. The slack in employment resulting from the shutting down of the all-out war production on which we are now embarking must be taken up in an orderly productive manner, if we are to prevent a catastrophe as severe as the war itself. We are certainly in a good position to learn from our recent experience with the depression how best and most economically the job can be done.

Great programs of economically justifiable public works will undoubtedly be undertaken, and engineers and others should now be planning, analyzing, and laying out these projects so that when the time arrives the blueprints will be ready. In the industrial areas where huge war industries are now being built up, great reservoirs of labor and equipment will be available for peace-time production after the present emergency is over. It seems to me that industrial engineers and planners should be developing means by which peace-time society can salvage some profit from this war-time necessity. Flood control and water conservation projects that are feasible and justifiable will undoubtedly be in the forefront during the post-war reconstruction period. It is right that they should be because the preservation of our natural resources is necessary for the continuation of the good life. Social freedom would be empty without economic freedom. An enormous amount of work will be required of engineers, foresters, economists, and other technicians before great numbers of men can be put to work on such projects. It is only by early and comprehensive study and planning that waste and inefficiency can be eliminated in the carrying out of these projects. It was found, in 1930, that industries cannot wait for plans to be formulated to take care of their workers. As soon as the demand for what they are producing is curtailed labor layoffs must follow.

We need to think about these things now, because we are not sure how soon the employment slack will need to be taken up. Colonel Bres expressed the situation very well when he said, "Traditionally it has been the policy of our national government, after a crisis has passed, to ignore entirely the need for preparedness to meet emergencies that may manifest themselves in the future. In the face of this policy to ignore the future, when an emergency such as the present one appears, our task for preparedness assumes the proportions of an overload burden."

ROGER E. AMIDON, Assoc. M. Am. Soc. C.E.
Riverside, Calif.

Manning's *n*

TO THE EDITOR: I was interested in Mr. Kennedy's article on "Relation of Reynolds' Number **R** to Manning's *n*," in the February issue, but the subject requires a further word. If we apply Manning's formula to pipes, where the experimental facts are somewhat better known than for channels, Kennedy's Eq. 1 may be written

$$f = \frac{185 n^2}{D^{1/3}}$$

where D is the diameter of the pipe in feet. For any single diameter, then, Manning's formula makes f a constant times n^2, and independent of both the velocity and the viscosity. The accompanying Fig. 1 (*a*) is a plotting of the case where D = 1 ft, superimposed on Fig. 94 of the writer's *Mechanics of Liquids*. (This latter is an extension of the relation found by Nikuradse between f and **R** plotted logarithmically.) It shows that at high velocities—that is, in the rough pipe zone—Manning's formula is quite satisfactory, that at one single value of V (for each viscosity) it gives the correct smooth pipe value, and that for all lower velocities it gives too low values of f. For example, when D = 1 ft and n = 0.010, the correct

f for smooth pipe, 0.0185, is given when **R** is about 90,000. For **R** = 4,000, Manning's formula gives $f = 0.0185$ instead of the correct value of 0.040. It is quite certain that the situation for channels will be similar.

A similar plotting for the single value of $n = 0.010$, and a kinematic viscosity of 0.0000125 sq ft per sec is shown in Fig. 1 (*b*). Each line represents one velocity, the Reynolds number being changed by varying the diameter. These lines form a crude approximation to the lines of equal absolute roughness shown on page 208 of the fourth edition of Daugherty's *Hydraulics*.

In models that preserve dynamic similarity to the prototype, the velocity in the model is the velocity in the prototype divided by the square root of the scale ratio. Therefore in Fig. 1 (*c*) lines have been drawn for various values of n for the case in which $V = \sqrt{D}$ and the viscosity is the same as before. This would be the situation in a series of undistorted models of various scale ratios, with the slope of the energy gradient = 0.0004 and Chezy's $C = 100$. Fig. 1 (*c*) shows that for this one case, $n = 0.0105$ would fit the smooth pipe curve fairly well through a wide range of Reynolds numbers. But this is far from saying that a hydraulically smooth model will preserve dynamic similarity with a hydraulically smooth prototype.

The same figure shows that if the prototype has $n = 0.025$ and a Reynolds number of 80,000,000, it will have $f = 0.025$. A 1:25 scale model of it will have a Reynolds number of 640,000, and if it has the same relative roughness, Fig. 1 (*c*) shows that it will have the same f as before, and that n will be 0.0146, which checks the rule that $n_r = L_r^{1/6}$. For a 1:400 scale model, the Reynolds number would be 10,000. To keep the same f (and thus preserve dynamic similarity) would require $n = 0.0092$. But no amount of smoothing of the model will keep f down to 0.025 because the smooth pipe curve shows that for this **R**, f will be 0.031. The case of open channels is similar, and a blind following of Manning's formula may lead to difficulties.

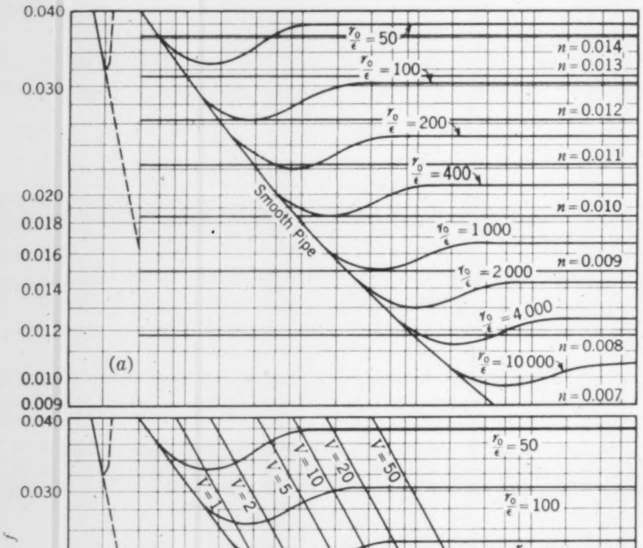


FIG. 1

RALPH W. POWELL, M. Am. Soc. C.E.
Associate Professor of Mechanics,
Ohio State University

Columbus, Ohio

Slide-Rule Computations

DEAR SIR: In the article on "The Decimal Point in Slide-Rule Computations" by W. D. McFarlane, in the March issue, the author mentions four rules given in slide-rule handbooks for determining the decimal point when using the C and D scales, and four more for the CI and D scales, or eight rules in all. Mr. McFarlane then states that he accidentally found a single rule which applies both to the C and D and to the CI and D scales.

The writer is not acquainted with the eight rules mentioned as appearing in slide-rule handbooks. However, for more than twenty years he has known one simple rule which is generally taught in Europe to beginners in the art of slide pushing. In fact, slide-rules of German manufacture actually have printed near the left-hand index of the D scale "Quot. + 1" and near the right-hand index "Prod. −1," which is a shorthand statement of the rule. This rule was originally intended to apply to the C and D scales, but it also applies to the CI and D scales.

For this method the actual number of figures to the left of the decimal point for numbers greater than unity taken with the positive sign, or the number of zeros between the decimal point and the first significant figure for numbers smaller than unity taken with the negative sign, are used. This is the same as the characteristics of the common logarithms plus one.

The rule may be stated as follows: In multiplication add and in division subtract the number of figures or zeros (algebraically, of course). If a product falls to the right of the factor on D-scale, subtract one; if a quotient falls to the left of the dividend on D-scale, add one.

Taking the author's example, we have the following procedure:

CI and D:	1,250,000 × 0.813	$(7 + 0 = 7)$
CI and D:	dividing by 64.3	$(7 - 2 = 5)$
CI and D:	multiplying by 2	$(5 + 1 - 1 = 5)$
C and D:	dividing by 0.426	$(5 - 0 = 5)$
C and D:	multiplying by 15,900	$(5 + 5 = 10)$
C and D:	dividing by 52.7	$(10 - 2 = 8)$
CI and D:	multiplying by 0.0107	$[8 + (-1) - 1] = 6$
C and D:	dividing by 0.429	$(6 - 0 = 6)$

Therefore, the result has six figures to the left of the decimal point—that is, it equals 558,000.

The rule takes longer to state than to apply. With use it becomes a sort of second nature and to the writer, at least, it seems simpler than the one accidentally found by Mr. McFarlane.

A. **SANTOS, JR.**, Assoc. M. Am. Soc. C.E.
Assistant Hydraulic Engineer,
The São Paulo Tramway, Light and Power
Company, Ltd.

São Paulo, Brazil

Notation for Partially Restrained Structural Members

TO THE EDITOR: I was interested in Mr. Suominen's article on "Partially Restrained Structural Members," in the February issue. In his notation, half the carry-over factors indicated in Fig. 2 (*a*) are so-called "nominal," and the other half are "modified." To the reader who does not already know the solution to the problem, this may be confusing.

The degree of restraint, f, mentioned by Mr. Suominen, is essentially the same as the degree of fixation defined by Hickerson in his *Statically Indeterminate Frameworks* (University of North Carolina Press, Chapel Hill, N.C.). Applying the Hickerson method to the problem given in Fig. 2, one may proceed in the following two ways, each serving as a check on the other:

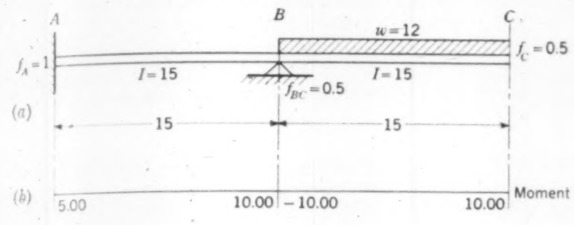


FIG. 1

(1) Using the formula $M_{BC} = -M_{CB} = \dfrac{-2f}{1+f}\,C_{BC} = \dfrac{1}{1.5}\,\dfrac{1}{12}$ (12) (15) = −10.00;

(2) Using the table of coefficients (page 92 of Hickerson's book),

$$M_{BC} = -CwL = -0.0555\,(12)\,(15) = -10.0$$

The foregoing results are final, no distribution is necessary (see the accompanying Fig. 1). Since end *A* is fixed, the carry-over factor is $+^1/_2$.

The similarity of the symbols used by Suominen and the notation of the Hickerson method are indicated in Table I. Obviously there is no point in using the formula $\dfrac{4f_B}{3+f_B}\,(^1/_2)$ instead of $\dfrac{2f_B}{3+f_B}$ for the carry-over factor.

TABLE I

	SUOMINEN	HICKERSON
Carry-over factor from *A* to *B*	$MCO_{AB} = \dfrac{4f_B}{3+f_B}\left(\dfrac{1}{2}\right)$	$\dfrac{2f_B}{3+f_B}$
Nominal stiffness	$\dfrac{4\,EI}{L}$	$K = \dfrac{I}{L}$
Moment at *A* if both ends are fixed	F_A	C_{AB}
Moment at *A* if end *A* is fixed	$\overline{MF}_A = -[F_A + F_B(\overline{CO}_{BA})(1 - f_B)]$	$M_{AB} = -C_{AB} - {}^1/_2(1 - f_B)C_{BA}$
Moment at *B* if end *A* is fixed	$\overline{MF}_B = +[F_B(f_B)]$	$M_{AB} = +f_B C_{BA}$

Charles H. Frick
Instructor in Mathematics
Montana State College

Bozeman, Mont.

Sub-Atmospheric Hydraulic Models

To the Editor: In recent months considerable discussion has centered around the usefulness and limitations of hydraulic models in which the atmospheric pressure surrounding the model is reduced in proportion to the linear scale ratio of the model. The opinion has been expressed that because the vapor pressure of the liquid cannot likewise be reduced, the usefulness of such a model is greatly limited. I should like to call attention to the fact that this limitation can be overcome by the addition of a constant to the atmospheric pressure in the model. Using a 1:15 scale model as an example, this constant can be computed as follows:

Atmospheric pressure in prototype	=	33 ft of water
Theoretical atmospheric pressure in model $\dfrac{(33)}{(15)}$	=	2.2 ft of water
Vapor pressure of liquid in prototype at 68 F	=	0.77 ft of water
Hypothetical vapor pressure in model $\dfrac{(0.77)}{(15)}$	=	0.05 ft of water
Constant to add to atmospheric pressure in model to make model and prototype cavitate at the same time (0.77–0.05)	=	0.72 ft of water
Actual atmospheric pressure to be used in model (2.2 + 0.72)	=	2.92 ft of water

With an atmospheric pressure of 2.92 ft of water in the model, the model will act like the prototype, cavitation occurring at the same places and under the same dynamic conditions as in the full-sized structure. It must be remembered, however, that because the general pressure level of the model has been arbitrarily increased by 0.72 ft of water, all pressure readings in the model will have to be corrected by subtracting this amount before transferring them to the prototype scale.

The formula for determining the atmospheric pressure to be used in the model in a general case would be as follows:

$$p_a = lP_a + (1 - l)V_P$$

where p_a = atmospheric pressure to be used in model (feet of water absolute)
P_a = atmospheric pressure in prototype (feet of water)
l = linear scale ratio of model (in example $l = {}^1/_{15}$)
V_P = vapor pressure of the water at specified temperature (feet of water)

Since it is generally admitted that flow conditions are unaffected by the atmospheric pressure surrounding a model, the above addition to the atmospheric pressure in the model will not produce any error in results. In any such testing, however, the effect of dissolved air on the results should be considered. H. A. Thomas, M. Am. Soc. C.E., and E. P. Schuleen, Assoc. M. Am. Soc. C.E., in their Madden Dam outlet tests solved the air problem by recirculating the water in a closed system and under a high vacuum until most of the dissolved air had been removed (PROCEEDINGS of the Society for November 1940, pages 1623 to 1658).

John C. Harrold, Assoc. M. Am. Soc. C.E.
Office, Chief of Engineers,
U.S. War Department

Washington, D.C.

Sabotage by Bacterial Infection

Dear Sir: The article, in the March issue, entitled "Bacterial Contamination Improbable as an Implement of War," by Carlo G. Flebus, was of much interest to me. I cannot say, however, that I agree with Mr. Flebus' conclusions in view of the weight of evidence to the contrary.

Although there is some basis for the belief that most pathogenic organisms will not persist for any great length of time in a body of water, bacterial contamination is known to persist for an extended time in the distribution system. Epidemics of water-borne diseases have been reported traced to accidental contamination of water supplies by organisms from an active case or from a carrier. Furthermore, a large percentage of the gastro-enteritis outbreaks each year, with high morbidity, are suspected, with good evidence, of being water borne. Although certain organisms are known to be associated with such epidemics, studies reveal that the cause is most often not possible of determination.

With regard to bacterial flora indigenous to certain continents, I believe there is plenty of evidence to show the transmission of infectious diseases from one continent to another with, if anything, increased virulence due to the lack of native immunization against the particular strain introduced. The acceptance of the so-called "germ theory" of disease is based largely upon the fact that the same species of organism will produce the same symptoms in case after case, regardless of the geographical location of the victim. It is true, however, that a number of strains of a particular species of organism may exist in different localities and even in the same locality. The virulence of such strains varies greatly, and it is often possible to develop weak strains of a given organism to the basis of a form of immunization whereby a weak strain of the living organism is introduced into the body in order to build up a natural immunization in the body against virulent strains of the same organism.

The author's allusion to the spread of tropical diseases by the introduction of infected hosts apparently refers to such diseases as plague and yellow fever, which are not water borne bu tare spread by certain species of insects. The Foreign Quarantine Division of the U.S. Public Health Service maintains a constant vigilance against such diseases by rigid inspection and fumigation of ships and aircraft arriving from possible sources of infection.

The 5-day oxygen-demand test is by no means routine for water supply examinations. The so-called "Treasury Department Standard," which forms the basis for routine water supply examinations, specifies the coli content as determined by the "Standard Methods of Water Analysis" of the American Public Health Association. There are certain other provisions regarding the sanitary aspects of the physical plant and the physical and chemical qualities of the water, but tests for these factors are not as general or as frequent as the routine test for coli. Further, the many test mediums now in use for E. coli determinations are by no means as inhibiting to other coliform organisms as Mr. Flebus implies.

During the past few years biologists have given attention to the use of certain plankton forms as indicators of pollution. The findings thus far have shown that while certain plankton forms are found in, and seem to prefer, polluted waters, the division between pollutional and non-pollutional species is by no means clear-cut. In any polluted body of water the zones of pollution, degradation, and recovery tend to overlap somewhat, and the organisms and processes naturally tend to do the same.

In addition to the sabotage of water supplies by bacterial contamination, the possible use of milk and other foods as a means of spreading bacterial infections should not be overlooked. Particularly, milk-borne epidemics may be quite widespread and disastrous. Pasteurization should be compulsory for all supplies in these troubled times and the utmost vigilance and care taken in protecting the distribution arrangements, particularly in our larger industrial areas.

It is sincerely hoped by the writer that those responsible for the safety of our public water supplies and those whose primary interests are in the protection of the public health will not allow themselves to be lulled into any sense of false security, but will maintain rather more than their usual vigilance in these matters.

CHARLES T. CARNAHAN, Assoc. M. Am. Soc. C.E.
Public Health Engineer, U.S. Public Health Service
Cincinnati, Ohio

Applicability of Triaxial Compression Tests

DEAR SIR: In the March issue there is a letter by William R. Perret criticizing an article by the undersigned, published in the January issue, outlining a new method for interpreting data from triaxial compression tests. The gist of this criticism is that the method outlined assumes that Mohr's envelope for soils is a straight line, whereas for most soils the envelope is curved. A careful reading of the article will show that while the analysis of the data obtained from tests on soils is not excluded from this method of analysis, the article dealt with the triaxial compression test in general. In fact in the body of the article it is pointed out that the method was developed because of the difficulty in analyzing the data obtained from tests on cement mortar cylinders.

We agree with Mr. Perret that when the envelope shows distinct curvature the data cannot be successfully analyzed by the method outlined. In our own work which is on materials other than soils, we would, if we found such a condition, critically examine our data to see if Mohr's theory was truly applicable to the material tested.

We, at the University of Washington, have been carrying on a series of triaxial compression tests of cement mortar cylinders. Certain data obtained from these tests have led us to question the interpretations that have been made of what might be called the classical examples of triaxial compression tests on materials other than soils—namely, those of von Kármán and Boker on marble and those of Richart, Brandtzaeg, and Brown on concrete.

Our tests were conducted on 4 by 8-in. cylinders in a steel chamber designed to withstand pressures up to 5,000 lb per sq in., the axial load being applied by a 200,000-lb screw-type machine. A large number of tests were made with lateral pressures varying from 100 to 2,400 lb per sq in. When the lateral pressures were increased above 2,400 lb per sq in., it was not possible to stress the specimens to failure in the apparatus available. At low pressures up to 600 lb per sq in. a number of the specimens failed by the splitting off of the sides with formation of cones at the ends, indicating that the failure was not by sliding but was similar to the type of failure in the ordinary compression test. As Mohr's theory applies only to isotropic material that fails by sliding, it was felt that the data obtained from tests on specimens that failed by a general splitting of the material should be rejected and that the data to be included in the analysis should be selected from those tests which definitely showed that failure was due to sliding.

This restricted the analysis to the data obtained on tests in which the lateral pressure varied between 600 and 2,400 lb per sq in. When the principal circles for these tests were drawn they extended over such a narrow range that the position of the envelope could not be determined with any surety. However, when the major principal stress was plotted against the minor principal stress, the graph drawn through the points for the selected data was found to be a straight line; whereas, if the questionable data from the tests with low lateral pressures were also used the graph would have to be a curve. This study led to the conclusion that the only reason for constructing a curved envelope to the principal circles would be to include within the envelope the principal circles based on data that were not pertinent to the investigation.

While pursuing this investigation it was thought it would be interesting if the data from von Kármán's and Boker's tests on marble and those from Richart, Brandtzaeg, and Brown's tests on concrete (as published in the Proceedings of the Purdue Conference on Soil Mechanics) were analyzed in a manner similar to that used in analyzing our own data. When this was done for the tests of von Kármán and Boker and all the data available were plotted, the graph showed distinct curvature, but when the highest and lowest values were eliminated the remaining points fell on a straight line. When the data of Richart, Brandtzaeg, and Brown were plotted in a similar manner—namely, omitting all values when the minor principal stress was less than 600 lb per sq in.—the results were even more interesting. For the 1:1:2 and the 1:2.1:2.5 mixes with the minor and intermediate principal stress equal, the plotted points fell on a straight line. For the 1:3:5 mix the points did not fall on a straight line and the graph constructed through these points was concave downward. However, no conclusion can be drawn from this graph, for when the data were checked against the original data (published in the University of Illinois Bulletin No. 185), it was found that the value given for the maximum load is the average of four tests, in three of which the maximum load, admittedly, had not been reached.

While we agree with Mr. Perret that the method outlined in our article is not applicable when the envelope to Mohr's circles shows a large degree of curvature, we have found that there is a wide field in which this method is applicable. This is especially true when the investigations are limited to the range that will produce data of value to the practicing engineer.

FREDERICK C. SMITH, Assoc. M. Am. Soc. C.E.
Assistant Professor of Civil Engineering
and
ROBERT Q. BROWN
Assistant Professor of General Engineering
University of Washington
Seattle, Wash.

Commerce Diversion—Suez to Panama

TO THE EDITOR: Military outcomes are unpredictable. At the moment, the possible capture of the Suez Canal and its closure to the British is a subject of conjecture. In this connection, data that I gathered during my engineering duties at the Panama Canal may be of interest.

The full name of the French-incorporated Suez Canal is the Compagnie Universele du Maritime de Suez, and the Canal has a board of 32 directors—19 French, 10 British, 2 Egyptian, and 1 Dutch. The Canal's neutrality and equality of use are guaranteed by international agreement. Such an agreement just now is, of course, only as good as the might of the British Empire; all the other signatories are either now aggressor nations, are already subjugated, or are in imminent danger of losing their independence.

In addition the Suez Canal concession reverts to weak Egypt within the next three decades. So, regardless of the outcome and aftermath of the German-Italian forays in the Mediterranean Sea, it is virtually assured that the Canal area is to know a series of intrigues and unrest which will be very detrimental to shipping.

Table I. Mileage Savings—Panama vs. Suez Canal in Marine Miles (from Hallberg's Study)

Route	Savings via Suez Over Panama	Savings via Panama Over Suez
London to Melbourne	1,803	...
New York to Melbourne	...	2,294
London to Sydney	28	...
New York to Sydney	...	2,460
London to Wellington	...	1,077
New York to Wellington	...	4,597
London to Calcutta	9,310	...
New York to Calcutta	4,790	...
London to Singapore	7,339	...
New York to Singapore	2,819	...
London to Yokohama	1,748	...
New York to Yokohama	...	2,772
London to Valparaiso	...	1,417
New York to Valparaiso	...	3,732
London to San Francisco	...	5,538
New York to San Francisco	...	7,853

And if the spirit of the present benign internationalization of the Canal is to be succeeded by nationalistically selfish shipping rules, there will tend to be wholesale revisions of traffic routes. The Capes' routes and the Panama Canal presumably are to be used in many cases formerly served by the Suez Canal.

Table II. Comparative Statistics of Canal Traffic Routes

	Panama	Nicaragua	Suez
Date opened to commerce	August 15, 1914	......	November 20, 1869
Length between terminals (Ocean buoy to buoy)	44 miles	173 miles	100 miles
Channel:			
Minimum width at bottom	300 ft	300 ft	200 ft 270 ft at turns
Minimum width at surface	300–1,000 ft	300–1,000 ft	400–500 ft
Maximum drafts of ship	40 ft**	40 ft**	34 ft**
Excavation:			
Total	419,467,555 cu yd	582,182,452 cu yd	.....
Deepest cut	494 ft	344 ft	50 ft
Locks	6 in pairs—110 × 1,000 ft (3 in pairs—140 × 1,200 ft under construction)	3 in pairs 125 × 1,200 ft	None
Dams	Gatun, earthen, 1½ miles long 22,958,069 cu yd Madden, concrete, 950 ft long 550,000 cu yd	Conchuda, concrete, 814 ft long 215,600 cu yd	
Yearly capacity	Over 107,000,000 net tons	Over 80,000,000 net tons	.....
Average transit time	8–10 hr	23–30 hr	13 hr
Transit speeds	6–15 knots	6–20 knots	7½ knots
Toll rates:			
Net tonnage, laded	$0.90	....	$1.38*
Net tonnage, in ballast	0.72	....	0.69
Net tonnage, displacement	0.50	....	1.38†
Transits (1939; Suez 1938):			
Net tonnage	27,170,007	....	34,418,187
Number of ships	5,903	....	6,322
Canal owned by	United States	United States	Suez Canal Company‡
Concession	In perpetuity	In perpetuity	Reverts Nov. 20, 1968
Parallel railroad	47 miles	110 miles + car ferry on Lake Nicaragua	105 miles
Protected entrances	Yes	Yes	Yes
Net capital investment:			
Existing canal (1904–1939)	$380,017,345§		
Present enlargements	277,000,000		
International Canal Board (Estimate)		$722,000,000‖	
Original cost (approximate)			$86,561,400¶

* The variable value of the franc, difference in system of measurements, and many changes in rates and rules during the past 20 years, make these uncertain.

** Depths of channel are 4 to 10 ft more; this for safer steering—that is, to prevent bottom swirls that affect the rudder and cause vessel-sheering.

† Passenger rate—all passengers aboard pay this.

‡ See text.

§ Including depreciation, value of capital stock of Panama Railroad, payments to Republic of Panama previous to 1921, but exclusive of compound interest on construction funds previous to 1921.

‖ Includes an estimate of $146,000,000 for construction-time management and administration, medical and sanitary work; also rights, franchises, lands, fortifications, etc.

¶ Has been extensively rebuilt; total cost not clear in the record. Basis of 1 franc = 20 cents.

From Table I it will be noted that the points wherein the Panama Canal competes favorably with the Suez are northeastern Asia, eastern Australia, New Zealand, and the west coast of North and South America.

The timing of the enlargement of the Panama Canal seems unusually apt. Will the shakedown of future events bring to realization the long delayed Nicaraguan route, too? In Table II herewith 1939 traffic figures are used as they are but slightly affected by the present topsy-turvy conditions resulting from the present war. The data on the Nicaragua route refer to recommendations of the 1931 Interoceanic Canal Board.

Ralph Z. Kirkpatrick

Rochester, N.Y.

Hydroelectric Power House Dimensions

To the Editor: The article on hydroelectric power house dimensions, by H. G. Gerdes, in the April issue, is of exceptional interest. The author's Fig. 2, which draws general relationships between spacing of units and the head in feet, is noteworthy in that it covers so wide a range of head. It seems to the writer rather questionable to follow it closely for heads below 30 ft, or above 300 ft. The writer has made use of the following formula for heads from 50 to 150 ft.

$S = \frac{52\sqrt{\text{hp}}}{H + 100}$ where S is the spacing in feet.

hp is the full-load capacity of the turbine in horsepower.

H is the head in feet.

Changing to kw and transposing, the ordinates of Fig. 2 become:

$$\frac{H + 100.}{61}$$

These plot a little on the best side of the range of Fig. 2, between the heads of 50 and 150 ft, for which the formula was designed. This limitation is desirable because it is within this range that the spiral casing dimensions are the primary factor covering spacing. For higher and lower heads, and for small units, other considerations enter with increasing effect.

The writer prefers hp to kw in these formulas, because it is directly related to the flow which fixes dimensions; kw is not necessarily related to flow, since it is a name plate figure which may vary with selected temperature rise.

The draft tube profiles shown in the author's Fig. 1 are of interest, if for no other reason than their close similarity in vertical dimensions. It is the writer's conviction that draft tubes are built more from habit and precedent than from economic analysis. A recent paper by A. R. Dawson in the April 1941 *Transactions* of the American Society of Mechanical Engineers shows very clearly how economic draft tube length may vary over a considerable range, depending on load factor and power value. His figures are reasonably comparable with the corresponding values that existed in the plants shown in Fig. 1. The inference is inevitable that many of these draft tubes were built without basic regard to economy.

For example, a draft tube designed for $40 power and 100% load factor may work out most economically with a height of three times the runner diameter. In contrast, $10 power and 50% load factor may require only half that relative height ratios of 3 and 1.5. The ratios of Fig. 1 apparently all fall between 2.8 and 2.1. Perhaps the explanation is that $10 power installations are less common in the United States than in Canada, although low-load factor plants are not.

Forrest Nagler, M. Am. Soc. C.E.
Chief Engineer, Canadian Allis-Chalmers, Ltd.
Toronto, Canada

SOCIETY AFFAIRS

Official and Semi-Official

What Is in Store at San Diego

Attractive Program Will Draw Many Engineers to the Annual Convention, July 23–25, 1941

San Diego, Calif., has been selected as the locale of the 71st Annual Convention of the American Society of Civil Engineers, July 23 to 25, inclusive, and all-out preparations are being made for an unusually large attendance. Headquarters will be in the U.S. Grant Hotel.

Delegates who remember with pleasure the Society's 1928 conclave, the only previous Annual Convention to be held in San Diego, will need no urging to attend. Those who have never visited the "Air Capital of the West" will find it of absorbing interest, particularly now when so much of Uncle Sam's preparedness activity is centered in that section of the Pacific Coast.

Discussion of various phases of our vast national defense problem as it affects the civil engineer will be featured during the Convention. While the detailed program is not yet ready for release, the following brief summary of Division meetings for each of the three days can be given:

Wednesday Morning, July 23
Business sessions

Wednesday Afternoon
National Defense

Thursday Morning, July 24
Highway Division
Defense Highways and California Freeways
Sanitary Engineering Division
Waterworks and Sewerage Practice in Southern California
Hydraulics Division
Hydraulic Model and Prototype Comparisons

Thursday Afternoon
Trip to Palomar Observatory

Friday Morning, July 25
City Planning Division
Business District Problems; San Diego Planning
Irrigation Division
All-American and Other Canals
Power Divisior
Dams and Power, Central Valley Project
Soil Mechanics and Foundations Division
Earth Dams; Power Plant Foundations

Friday Afternoon
Irrigation Division
Land Classification; Local Irrigation Features
Power Division
Power Market; Concrete Dam Maintenance
Soil Mechanics and Foundations Division
Stabilization; Transmission Tower Foundations
Hydraulics Division

In advance of the general opening sessions of Wednesday, there will be a Local Sections Conference and a Junior Forum on Tuesday, July 22.

An attractive assortment of trips and novel entertainment features are scheduled for lady visitors. From beckoning mountains, seashore, Old Mexico, and the countless points of historic interest which abound in San Diego, the ladies entertainment committee has selected highlights calculated to appeal to all. In addition to the usual sightseeing parties, teas, luncheons, and a dinner dance under the stars, the ladies will be guests of honor at a dress parade of one of the largest Naval establishments in the West. They will also have an opportunity to meet and hear Mrs. Belle Benchley, director of the third largest zoo in the world, author of last year's best seller, "My Life in a Manmade Jungle," and recently named one of the ten outstanding women in America.

The Thursday afternoon trip to Palomar Observatory is expected to provide the No. 1 thrill of the entire convention. Arrangements have been perfected for a specially conducted tour through this observatory, where everything is in readiness for installation of the 200-in. telescope, the glass giant in which the interest and

Review of Marine Corps at Its San Diego Base, with City's Skyline as a Background

San Diego's Downtown District and Bay, as Viewed from Beautiful Balboa Park

hope of astronomers and scientists the world over have been centered for the past three years. Atop Palomar Mountain, one of the highest and most beautiful peaks in San Diego County, a fiesta atmosphere will prevail throughout the afternoon. Strolling musicians will lend color to an old-fashioned barbecue after the manner of the days of the Dons, and a competent corps of chefs will be in charge.

A special attraction of San Diego is its harbor, one of the finest in the West. A close-up of its attractions will be given those who take the boat trip which is being arranged for the attending members.

By special courtesy of the Mexican National Commission of Irrigation, those who remain through Saturday will be taken to Rodriguez Dam in Baja California, the highest Ambursen-type dam of North America. It is situated a few miles from Tijuana, and all who wish will have an opportunity to explore that quaint little Mexican town.

While we have the assurance of the San Diego Section that ample hotel accommodations are available, it is suggested that delegates make their reservations early. Final details of the technical program and the social events in store at San Diego will be found in the official program of the Convention, to appear in the July issue.

Resolution Commemorates Dr. Otis E. Hovey

One of the first actions of the Board of Direction at its Baltimore meeting on April 21, was to provide for suitable recognition of the long and notable activity of Otis E. Hovey, Hon. M. Am. Soc. C.E., in connection with Society work, especially his 20 years of service as Treasurer of the Society. A special committee reported on suitable resolutions, which were adopted in the following form:

"Whereas, the members of the Board of Direction of the American Society of Civil Engineers have been deeply grieved to learn of the death on April 15, 1941, of Dr. Otis E. Hovey, Honorary Member and Treasurer of the Society; and

"Whereas, Dr. Hovey has long been a distinguished member of the civil engineering profession, a leader of his fellows, and a world authority on steel structures; and

"Whereas, he has earned the deep gratitude of all engineers for his ceaseless work in promoting the technical and and administrative activities of the Society, and especially for his loyal and efficient service as its Treasurer for almost precisely twenty years; and

"Whereas, he has been so justly admired for his fine Christian character and integrity, and will long be remembered for his volumes on movable bridges, which are considered a standard reference, and his numberless contributions to engineering research, more particularly in recent years as Director of Engineering Foundation;

"*Now, therefore, be it resolved*, by this Board, assembled at its meeting in Baltimore, Md., April 21, 1941, that it records its sincere admiration for Dr. Hovey, as a man and as a fellow engineer, and its profound sense of loss in his death; that it extends its deepest sympathy to his family, and directs that this resolution be made a part of its official minutes, and that a copy be forwarded to Dr. Hovey's family."

Completion of Work on Stresses in Railroad Track

Over a period of 27 years the Society has participated in an extensive research on the subject of Stresses in Railroad Track. This has been under the able leadership of Prof. Arthur N. Talbot, Hon. M. Am. Soc. C.E. The effort has been a joint one, the American Railway Engineering Association having also been active in the combined work.

Although the Committee was authorized in November 1913, it actually got under way in the spring of 1914. Yearly reports appeared in Proceedings from 1915 onward, with very few exceptions. In 1920 there were three such reports. Some of these records are monumental, such as those in Transactions for 1918, 1919–1920, 1923, 1925. The latest Committee report issued by the Society appeared in Proceedings in 1928; thereafter these extensive reports were filed in the Engineering Societies Library, and the general printing was handled by the A.R.E.A.

The stated purpose of this Committee has been "to investigate the stresses in railroad track resulting from the action of ties, ballast, roadbed, and their appurtenances in resisting the forces applied by locomotives and cars at rest and in motion." How well the Committee has succeeded is ably recorded in its remarkable reports. In discontinuing the Committee, the Board gave point to its recognition of this most valuable work by its sincere vote of thanks.

Similar action has been taken by the A.R.E.A. with regard to its committee, whose membership was identical with that of the Society committee. The following have represented the Society in this notable work: Arthur N. Talbot, Chairman, W. J. Burton, W. M. Dawley, C. W. Gennet, Jr., H. E. Hale, Floyd S. Hewes, George W. Kittredge, Paul M. LaBach, F. R. S. Layng, John deN. Macomb, William H. Penfield, G. J. Ray, A. F. Reichmann, H. R. Safford, F. E. Turneaure, J. W. Willoughby, and Louis Yager.

Courtesy The Hughes Co.

Part of the Four Hundred Merrymakers at the Dinner and Dance, Wednesday Evening, April 23

Baltimore Meeting a Huge Success

Splendid Planning of Technical Program and Social Details Pays Dividends

Everyone predicted that the Baltimore Spring Meeting would be a grand success—and the meeting itself proved that everyone's anticipation was correct. The attendance was large, the sessions were enthusiastic, the entertainment was lavish, and the enjoyment was continuous. From beginning to end, there was not a dull moment.

As a matter of fact, the sociability began before the meeting itself was scheduled to start. A number of unique advance features were introduced. The first official event was a delightful supper party given by Capt. V. S. Doebler, life member of the Society, at his lovely home in Guilford. On a spacious lawn, during the twilight and by candlelight under the stars, a fine buffet supper was served. On the next day, the Board members were entertained at luncheon by the Engineers Club of Baltimore. That evening, the firm of Whitman, Requardt and Smith entertained at its new offices—a sort of housewarming with inspection and buffet supper.

A "Silver Jubilee" Dinner

A unique function was planned for the following evening, Tuesday, also at the Engineers Club of Baltimore. This invitation affair, planned particularly for those who had attended the Baltimore Meeting in 1914, with the present officers of the Society especially invited, was appropriately called a "Silver Jubilee and Reunion Dinner." Informality, cordiality, and excellent food marked this as well as all the other social gatherings. The "old-timers" had a great time, and for some of them the party lasted well into the morning.

The ladies who were present during Sunday, Monday, and Tuesday, while the Board was in session, found a full program awaiting them. In addition to parties on Sunday and Monday evenings, they visited the museum and library of the Maryland Historical Society on Monday morning, took a boat trip around the harbor, ending with a repast at Ye Olde McCormick Tea House on Tuesday afternoon, and in between found time for numerous other sightseeing trips in the private cars that seemed always to be ready and waiting for the guests.

Officers and Board Members Entertained at Luncheon, Monday, April 21, by the Engineers Club of Baltimore

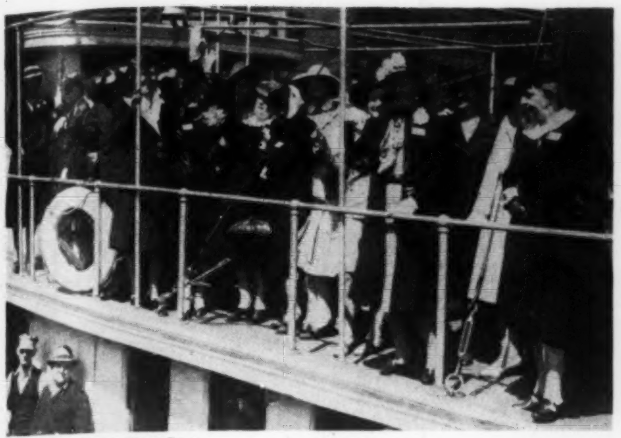
Meanwhile, much Society business was being transacted. All day Sunday, Monday, and Tuesday, committees of the Board as well as the Board itself were meeting. A Local Section Conference held all-day sessions Tuesday, and that afternoon the Technical Procedure Committee met in an extended session, which was finally completed the following morning.

Meeting Begins

The Society meeting itself began auspiciously on Wednesday morning, April 23, at the Lord Baltimore Hotel. After a greeting by President Allner of the Maryland Section, both Governor O'Conor of Maryland and Mayor Jackson of Baltimore brought warm welcomes. President Fowler responded enthusiastically, and the meeting was off to a promising start. The main topic of the morning was the significance of the Chesapeake Bay area, presented ably and with delicious bits of subtle humor by Professor Wolman of Johns Hopkins University.

At noon on Wednesday occurred another unique feature of the Baltimore Meeting. At an "Authors' Luncheon" there were brought together the speakers, principal discussers, and presiding officers of the Meeting sessions in an informal gathering where there was ample opportunity for getting acquainted and for discussing procedure. It was an occasion that can well bear repetition and elaboration.

In the afternoon the Engineering Economics and Structural Divisions met at the headquarters hotel, also the Highway and City Planning Divisions in joint session. Meanwhile the Waterways Division, with its large attendance, enjoyed the ample quarters of the Baltimore Engineers Club nearby. On Thursday morning, the Sanitary Engineering, Power, and Construction Divisions held simultaneous meetings at the Hotel. All these sessions were large and enthusiastic. Especial interest centered in the talk by Chairman Eastman of the Interstate Commerce Commission, before the Engineering Economics Division, and that by General Robins, Assistant to the Chief of Engineers, before the Construction Division.



Courtesy Baltimore News-Post

LADIES READY FOR THE HARBOR TOUR, TUESDAY, APRIL 22
They Returned in Time for Refreshments at One of Baltimore's Quaint Old Tea Houses

SUPPER AFTER THE POWER HOUSE INSPECTION
Guests of Safe Harbor Water Power Corporation Refreshed on Tailrace Bridge Overlooking the Susquehanna River

For the benefit of all members, a number of these splendid presentations will be printed in Society publications.

Not scheduled in advance but arranged in response to a last-minute call of National Chairman Binger and Vice-Chairman Goodrich, the Committee on Civilian Protection in Wartime held a well-attended breakfast meeting on Friday at 8 a.m.

The only rain during the whole week failed to dampen the popularity and success of the dinner and dance at the Hotel on Wednesday evening. Nautical decorations gave an effective setting to the ballroom. Fine vocal and instrumental music was presented. The talks were brief and spontaneous. Following the dinner, dancing was enjoyed till early morning.

ALSO EXCURSIONS

For Wednesday and Thursday, a total of 21 individual or group inspection trips were arranged to various plants, projects, and points of interest in and near Baltimore. The more popular of these were visits to the tidewater terminals of the Baltimore and Ohio and Western Maryland railroads, the Bethlehem Steel Company Plant at Sparrows Point, the Rustless Iron and Steel Corporation, and the Maryland Academy of Sciences. The harbor inspection trips by boat on the morning and afternoon of both days also proved very popular.

All technical sessions closed before noon on Thursday, to provide for an afternoon trip by electric train up the Susquehanna River. In the middle of the afternoon the party reached Holtwood. There one group inspected the dam, power house, hydraulic laboratory, and steam station. Special interest was shown in the method of extracting the vast quantity of river coal used in the steam plant from the lake above the Holtwood Dam, where it had been deposited as sediment washed down from the anthracite region of northeastern Pennsylvania. While this group was visiting Holtwood, another party went by boat across the lake and enjoyed a visit to the unique Indian Steps Cabin Museum, a noted exhibit of local Indian relics, where a ceremony was conducted by the Conservation Society of York County, custodian of the museum, in honor of the founder, the late Judge J. E. Vandersloot.

Both parties joined at the Safe Harbor development a few miles further upstream, where the special train was parked right on the intake deck of the plant. Here the design, construction, and operation of this large hydroelectric plant were fully explained by a fine exhibit of engineering drawings, pictures, diagrams, maps, and charts. A number of the guests enjoyed a short bus tour to the nearby model village where the power company's employees live, and to the observation site on the hills above the river.

By this time everyone was more than ready for the excellent buffet supper that had been provided. A long covered pavilion with wooden seats and tables had been built over the tailrace bridge of the power plant, where the guests were bountifully entertained by the Safe Harbor Water Power Corporation. As the supper was completed and the party entrained again for the return trip, a wonderful sunset over the lake above the power house lent a fine concluding touch. It was as if this spectacle had been arranged for along with all the other carefully worked out details. The guide service was plentiful; the signs and directions were exact; special walkways and railings had been made for convenience and safety; the supper was fit for the picnickers' appetites; and then came the sunset. On the way back to Baltimore there were more refreshments and more jollification.

Courtesy The Hughes Co.

AUTHORS' LUNCHEON, WEDNESDAY NOON, BROUGHT TOGETHER SPEAKERS, DISCUSSERS, AND PRESIDING OFFICERS JUST PRIOR TO THE DIVISIONS' TECHNICAL SESSIONS

REUNION DINNER FOR "ALUMNI OF BALTIMORE'S 1914 CONVENTION" AND SOCIETY OFFICERS
Many Enlarged Reproductions of Letters from "Old Timers" Were Displayed on the Walls

All day Friday was devoted to the concluding trip—to Annapolis. A special boat had been chartered. Again the weather was propitious. Coming on the boat at ten o'clock, the visitors were greeted with barrels upon barrels of oysters, clams, and shrimps, not to mention beer and soft drinks. As the boat left Baltimore, a fine view was gained of the harbor, of a special display by a fireboat, of noted Fort McHenry, of the Municipal Airport, of the great Sparrows Point plant of the Bethlehem Steel Company, as well as of numberless other points of interest.

On board the boat was held the second general session of the Spring Meeting. Again the subject was the Chesapeake Bay area, and particularly the problems of conservation of crabs, oysters, and other sea food.

Following lunch on board, the part arrived at Annapolis about 1:30 p.m. and were taken in hand by young Naval officers who treated them to a thorough inspection of a large number of buildings, shops, laboratories, and exhibits around the Academy. Then came an infantry drill on the Parade Grounds, after which the large group repaired to the Governor's Mansion where the First Lady of the State served tea. The majority of the visitors took advantage of the opportunity to see the Hammond-Harwood House, one of the historic colonial homes of Annapolis, which was open, under special arrangement, to all participants in this trip.

About sundown the party again embarked. Meanwhile other viands had been in preparation, including crab soup and crab cakes—famous Maryland delicacies. It almost seemed that this boat trip was one continuous feast. What was more remarkable was that at its conclusion there still remained more barrels of oysters in reserve. Music was provided and many enjoyed the dancing during the return trip to Baltimore.

During all these days the ladies were being royally entertained. On Wednesday, the out-of-town ladies were guests at a luncheon and bridge party at the Baltimore Country Club, given in honor of Mrs. Fowler, wife of the President. Trips around town and visits to art galleries and clubs in the brief intervals between the major events on the main program were very much enjoyed.

Mention should also be made of the fine Student Chapter Conference held all day Wednesday at the Johns Hopkins University, with an inspection trip in the afternoon to the Chevrolet Company and Fisher Body Company plants, and a special dinner at the University in the evening.

ENGINEERING ON DISPLAY

On the mezzanine floor of the Headquarters Hotel there had been prepared a number of most interesting engineering exhibits. Without attempting to catalog all of these, reference may be made to the displays of WPA work on dams, airports, and parks; models from the Pittsburgh U.S. Engineer Office, including towboats, several dams, locks, wickets, and other devices; a fine model of the Safe Harbor Power Station; railroad exhibits, including photographs, models, rail sections, trusses, and rolling stock, from the

PARTY FOR INDIAN STEPS CABIN MUSEUM
Converted River Coal Barges Ready to Leave McCalls Ferry, Thursday Afternoon, April 24

Upper Deck Was Popular on the Annapolis Trip
Watching the Receding Skyline as Chartered Steamer Leaves Baltimore, Friday, April 25

Ceremonies at Indian Steps Museum
Society Party, Addressed by J. A. Walls, President, Pennsylvania Water and Power Company

Western Maryland and the Baltimore and Ohio railroads; views and models from the Martin aircraft factory, the Port of Baltimore, and the U.S. Bureau of Reclamation; the City of Baltimore, including its Bureaus of Sewers and Water Supply, with plans and models and even some fine examples of old wooden water mains; the State Road Commission's exhibits and maps; also data on the state plane coordinate system; charts and equipment from the Pennsylvania Department of Forests and Waters; and finally from the U.S. Geological Survey's Water Resources Department, a number of fine models of stream gages, maps, and charts. As part of the exhibits, moving pictures were shown of the Pennsylvania Turnpike and of the 1936 Flood on the Susquehanna River. In an adjacent room the visitors enjoyed colored talking pictures on Baltimore and on urban transportation problems. These numerous exhibits were under continuous inspection by members and guests throughout the meeting.

No description could adequately cover the perfection of planning and detail that marked the Baltimore Spring Meeting, including of course the ladies' program. In spite of the extensiveness of the events, the necessity for close scheduling, and the large attendance to be provided for, not a single hitch developed—at least no evidence of even a minor lack was visible. Copious literature covered all the arrangements. Chairman Greiner, President Allner, Director Requardt, and their aids overlooked no detail; committee members were always in attendance and were much on the job. A fine patronage of members and guests from Washington, Philadelphia, New York, and other more distant centers was a tribute to the Baltimore advance planning.

In the light of all this it is hardly a wonder that the total registration reached 1,150, which is certainly one measure of the appreciation everywhere felt and expressed. This meeting will long be remembered as one of the most elaborate, and yet one of the most easily enjoyed, of any in the Society's history.

No acknowledgment could do full justice to the numerous treats that were enjoyed by this large and enthusiastic Spring Meeting. The photographs here reproduced can give but an incomplete conception of the warmth and depth of Baltimore's hospitality to its friends in the Society.

Donald P. Barnes, Editor of "Civil Engineering," Called to War Service

First of the Society's technical staff to be called into war work is Donald P. Barnes, Assoc. M. Am. Soc. C.E., until recently editor of Civil Engineering. By coincidence, he was also the most recent addition to the Society's Headquarters staff of engineers. He is now Major, Corps of Engineers, assigned to the Engineer Board, Fort Belvoir, Va. In particular his work has to do with camouflage, a subject on which he had considerable training as a reserve officer. His Army appointment was effective April 28, 1941.

When he came to the Society last summer, Major Barnes had a background of a valuable experience as a Freeman Scholar, in consulting offices of the Los Angeles district dealing in structures and hydraulic engineering, and especially for a number of years with the Bureau of Reclamation in soils, hydraulics, and pump problems. During the less than one year in which he held the editorship of Civil Engineering, he rendered valuable work in maintaining the high standards of that Society publication. Severance of these relations was the subject of regret on his part as well as by his staff confreres.

This position has been filled by the appointment of Howard F. Peckworth, M. Am. Soc. C.E., as noted in a separate item. Mr. Peckworth has already taken up his new duties at Headquarters.

Committee Members

The names of B. A. Bakhmeteff and A. A. Kalinske were inadvertently omitted from the list of members of the Committee on Hydraulic Research of the Hydraulics Division in the 1941 Yearbook. Both are cooperating members of this committee and should have been listed as such.

Enlarging Section Membership

Presented Before Local Sections Conference, Baltimore, Md., April 22

By Charles A. Howland, Assoc. M. Am. Soc. C.E.
Vice-President, Philadelphia Section

An effort to secure new members, either new members of the Society or subscribing members in a Local Section, is most successful when the Section activities are generally attractive. Interesting meetings, energetic committee work, and undertakings for the advancement of the profession make a Section more attractive to those not already members of it, and make those who are members feel that the Section is worth supporting.

Any campaign to increase membership has, undoubtedly, the best chance of success if it is well planned and carefully organized. The Philadelphia Section's experience has indicated that a survey of prospects is an important first step in planning a campaign. When we undertook to increase the number of members who pay Section dues, the chairman of the committee went through the file of non-subscribing members and picked out the most likely prospects. Those who live and work near the usual place of meeting are more likely to become subscribing members than those who live at a considerable distance.

Cards were made giving the name, address, and professional connection of the prospect. Volunteers offered their services to supplement our regular committee in interviewing the prospects and each interviewer was assigned three or four cards of non-subscribing members whom he could see conveniently. In this way, personal contact was made with the prospect, often by someone who knew him. As a result, about 35 new names were added to the roll of subscribing members in a period of a few months. This activity is a continuing one but is not quite so intensive at all times.

Whenever a member of the Society moves into our area or an engineer in our District joins the Society, a letter is sent to him by the Section President welcoming him as a member of the Section. He also receives a Section Yearbook and is invited to become a subscribing member of the Section.

Furthermore, we try not to forget a new member. We have an active reception committee which meets new members, introduces them to their fellow members at the first dinner they attend preceding a Section meeting, and tries to make them feel at home.

Program Planning

Presented Before the Local Sections Conference, Baltimore, Md., April 22

By EMIL A. GRAMSTORFF, ASSOC. M. AM. SOC. C.E.
SECRETARY-TREASURER, NORTHEASTERN SECTION

THE NORTHEASTERN Section generally plans for from five to six meetings a year scheduled between the various technical programs offered each season in Boston. This somewhat haphazard procedure is now causing us difficulty and the executive committee is giving more definite thought to the matter of program planning. Many problems increase the difficulty of finding an adequate solution. There are about eighteen engineering organizations, either national sections or local organizations, that have headquarters in Boston. Fifteen of them have affiliated, forming the Engineering Societies of New England, Inc. Each of these eighteen sections or organizations conducts from two to thirty meetings each season, including the E.S.N.E., itself.

Of these eighteen organizations, four are strictly associated with civil engineering: The Boston Society of Civil Engineers, Massachusetts State Engineers Association (largely social in the character of its meetings), New England Water Works Association (reasonably active), and American Water Works Association (comparatively inactive). Of these four, the Boston Society, comprising 755 members largely in Massachusetts, with about 475 members in metropolitan Boston, conducts a regular monthly meeting on the third Wednesday of each month from September to June, inclusive. In addition, it operates a Sanitary Section meeting the first Wednesday of the month, four times each season; a Designers Section meeting on the second Wednesday of each month from October to May, inclusive; a Highway Section meeting on the fourth Wednesday of four months; and a Hydraulics Section meeting on the first Wednesday for the three months not reserved by the Sanitary Section.

Of the 605 members in the Northeastern Section, about 170 are also members of the Boston Society of Civil Engineers, which maintains an extremely active program, averaging better than three and a half meetings a month throughout the season. An examination of the E.S.N.E. *Journal* for the past month and a half shows scheduled activities of its organizations of from two to six meetings a week, or an average of four and one-half meetings a week. Our local problem of program planning, therefore, is to attract a reasonably large number of the Section membership and try to schedule our five or more sessions without conflict of interest and without too much wear and tear on the membership from evening engagements.

From a study of the program schedules of these various societies, it was found that the first and fourth weeks of the month were used the least, and we have agreed to try out a plan whereby our meeting will occur on a fixed evening throughout the season. The fourth Monday has been selected as the least used and most favorable night in the least active week of any month and it is our hope that eventually the members will automatically reserve that date.

Local Section Conference in Baltimore

REPRESENTATIVES from the 22 Eastern Sections of the Society met in Baltimore at the Lord Baltimore Hotel on Tuesday, April 22, the day prior to the opening sessions of the Spring Meeting of the Society, for an all-day round-table discussion of problems of particular interest to the administrative officers of Sections.

The program emphasized national defense employment for civil engineers; ways and means of assisting Juniors to help themselves; Local Section administrative details such as annual reports, programs, accounting practices, and membership improvement; and Section publications and publicity.

Every representative contributed to the lively discussion. Two of the papers are abstracted on this and the preceding page.

REPRESENTATIVES AT BALTIMORE LOCAL SECTIONS CONFERENCE

Front Row, Left to Right: Frederick H. Paulson, Secretary-Treasurer, Providence Section; Prof. M. O. Fuller, Secretary-Treasurer, Lehigh Valley Section; Prof. Cecil S. Camp, Secretary-Treasurer, Syracuse Section; Prof. E. A. Gramstorff, Secretary-Treasurer, Northeastern Section; Nathan C. Grover, District of Columbia Section; George Finck, Past-President, Maryland Section; Hal H. Hale, Local Sections Committee, Atlanta, Chairman of Conference; Clifford A. Betts, President, District of Columbia Section; R. D. Buck, Assistant Secretary, Connecticut Section; Lt. Col. Thomas B. Larkin, President, Panama Section.

Middle Row, Left to Right: Louis P. Blum, President, Pittsburgh Section; Dean Thorndike Saville, Vice-President, Metropolitan Section; John F. Reynolds, Past-President, Florida Section; F. M. Bell, Secretary-Treasurer, Georgia Section; H. T. Ware, Vice-President, Ithaca Section; Leroy S. Edwards, Secretary-Treasurer, Miami Section; Arthur L. Vedder, President, Rochester Section; Theodore Bloecher, Jr., President, West Virginia Section; Dean Wallace C. Riddick, Past-President, North Carolina Section; Charles A. Howland, Vice-President, Philadelphia Section.

Back Row, Left to Right: Walter E. Jessup, Field Secretary, Am. Soc. C.E.; Prof. E. L. Clarke, Past-President, South Carolina Section; Wallace B. Carr, President, Buffalo Section; Perley A. Rice, Secretary-Treasurer, Virginia Section; Prof. G. Reed Shaw, Secretary, Mohawk-Hudson Section; M. B. Garris, President, Miami Section; Benjamin E. Jones, Secretary, District of Columbia Section; William H. Richards, Jr., District of Columbia Section.

Student Chapter Conferences Held

Interesting and Varied Programs Presented at Spring Gatherings

Regional Student Chapter Conferences, held under the auspices of the Society's Committee on Student Chapters, continue to flourish. There are now fourteen such conferences, at which the Chapters in the different areas take turns acting as host. The planning and management are entirely in the hands of student officers and committees, and in many respects the conferences are similar to Society meetings on a small scale. The seven reports presented below clearly show that the students have handled their responsibilities well, and they are to be sincerely congratulated on their good work.

CAROLINA—APRIL 18–19

The Carolina Conference of Student Chapters was held in conjunction with the annual Engineers' Fair at North Carolina State College. Delegates arrived at Raleigh on Friday afternoon, April 18, and were conducted to their rooms by members of the host Chapter at North Carolina State. They were then shown through the Engineers' Fair.

The formal meeting was called to order on Saturday morning by H. W. Fox, president of the North Carolina State College Chapter and of the Conference. Prof. T. S. Johnson, contact member for the Chapter, welcomed the delegates from The Citadel, Duke University, and Clemson College, and expressed regret that the University of South Carolina Chapter could not be represented.

Then Prof. C. L. Mann, faculty adviser for the local Chapter, introduced Charles Ross, general counsel for the North Carolina State Highway Commission, who gave an excellent address on the "Human Side of Engineering." Next, J. R. Tomlinson, chief concrete inspector for J. N. Pease and Company, told of the work being done at Fort Bragg on the national defense expansion program.

After a short intermission, papers were presented in the annual student prize competition, D. S. Abell and J. M. Terry acting as judges. First, Arthur Alpert, of Duke University, presented a paper on "Model Analysis of Indeterminate Structures," basing his observations on experimental work that is being carried on at Duke. J. M. Smith, of North Carolina State College, read a paper on "Construction Methods Used on the Fort Bragg Water Tank," while J. H. Osborne, of Clemson College, had chosen the "Action of Piles" for his subject. The first prize of $15 went to Mr. Smith, second prize of $10 to Mr. Alpert, and third prize of $5 to Mr. Osborne. The prizes were given by the North Carolina Section, and presentation was made by Prof. T. S. Johnson.

During the business session the following officers were elected for the coming year: J. D. Glenn, of Clemson, president; W. M. McLaughlin, of Duke, vice-president; and J. W. Weathers, of The Citadel, secretary-treasurer. Next year the Conference will be held at the University of South Carolina.

In the evening the delegates were guests of honor at the Annual Engineers' Brawl held in the Frank Thompson Gymnasium on the State College campus.

MID-CONTINENT—MARCH 21–22

The first annual meeting of the Mid-Continent Conference of Student Chapters was held at Columbia, Mo., on March 21 and 22, with the University of Missouri acting as host Chapter. Friday morning was spent registering the delegates, and a "get-acquainted luncheon" followed.

In the afternoon the first general meeting was called to order by President Charles Baer, and the roll call was answered by the University of Arkansas, the Missouri School of Mines, Kansas State College, the University of Missouri, the University of Kansas, and the University of Oklahoma. The University of Nebraska, Oklahoma Agricultural and Mechanical College, and Washington University were not represented at the Conference.

This session was devoted to a frank discussion of Student Chapter problems and activities. Methods of financing the Chapters were covered in some detail. It was found that Chapter dues varied between a dollar and a dollar-fifty, and in many instances extra assessments were made to pay for special activities such as smokers, barbecues, and dinners. Attendance at meetings was also discussed, and it was brought out that general interest in Student Chapter affairs is stimulated by the use of slides and prepared lectures from the Society, and by holding interesting contests—for the best student paper, the highest scholastic average, the hardest-working student during Engineers' Week, and so on. It was found that the frequency of meetings varied from one to four per month.

Later there was a vigorous discussion on the subject of the membership of students in the Society. After due consideration and discussion the following motion was moved, duly seconded, and passed by a unanimous vote of the Conference: "The secretary-treasurer shall inform the North Carolina Student Chapter of the American Society of Civil Engineers [which has proposed replacing Student Chapters with full Society membership of student grade] that the member Chapters of the Mid-Continent Conference are not dissatisfied with their present status as Student Chapters, but any action in this connection initiated by the Society will be supported."

On Saturday, March 22, the general business meeting was called to order at 9:00 a.m. Later the Conference was temporarily adjourned, so that the group might hear Harland Bartholomew, city planning consultant of St. Louis, speak on city planning.

After further business discussion, the following officers were elected for the coming year: T. A. Hughes, of the Missouri School of Mines, president; Max Allen, of the University of Arkansas, vice-president; and Robert Gilles, of Kansas State College, secretary-treasurer.

It was unanimously approved that Kansas State College be the host Chapter for the second annual Conference. A vote of thanks for a well-planned Conference was given to the University of Missouri Student Chapter. An informal luncheon and a conducted tour of Columbia concluded the Conference.

NEW ENGLAND—APRIL 25

Registration for the fourth annual meeting of the New England Conference of Student Chapters took place at Brown University on April 25. There were 115 delegates, representing the Student Chapters at Rhode Island State College, the University of New Hampshire, Brown University, Worcester Polytechnic Institute, Norwich University, Massachusetts Institute of Technology, Tufts College, Northeastern University, Yale University, and the University of Connecticut.

The business meeting was called to order at 2:30 in the afternoon, with Dr. Bruce M. Bigelow, associate dean of the college, delivering the address of welcome. Dr. Bigelow cautioned the group against short-cuts in engineering training, and emphasized that such training without instruction in the fundamental sciences is of little value. Following his address Donald MacLeay, on behalf of the Norwich University Chapter, invited the group to attend the Fifth Annual Conference at Norwich next year. William F. Allen, Jr., president of the Brown Chapter and presiding officer, then explained to the delegates that a large part of the business meeting would consist of a discussion of each Chapter's activities. This discussion period lasted about an hour. The brief addresses were well prepared and delivered, and the consensus of opinion seemed to be that they represented a considerable improvement over the past practice of having impromptu reports on the year's activities.

Following the discussion period, the two prize papers in the annual student prize contest were delivered. The first paper—on "Prospecting for Iron Ore"—was presented by Robert S. Wilmot, of Brown University. The second paper, which dealt with the construction of Camp Edwards, was delivered by C. E. Moffet, of Massachusetts Institute of Technology.

Immediately after the meeting the accompanying group picture of all the Chapters represented was taken in front of the John Carter Brown Library. Inspection of the campus and laboratories followed.

At the banquet in the evening Harold E. Miller, who was in charge of the prize paper contest, introduced the Prize Paper Committee, consisting of Daniel O. Cargill, Robert L. Bowen, and

THE BROWN UNIVERSITY CHAPTER IS HOST TO THE NEW ENGLAND CONFERENCE OF STUDENT CHAPTERS

George J. Geiser. Mr. Cargill, who presented the prizes, explained that the committee could not distinguish between the two prize papers and was therefore awarding both Mr. Moffet and Mr. Wilmot first prizes of $15.

The toastmaster, W. F. Allen, Jr., then introduced the speaker, J. Burleigh Cheney, president of the Providence Engineering Society. Mr. Cheney told the group that there is no short-cut to success—hard work and the ability to sell one's self are still the two important prerequisites for success.

The conference adjourned at the close of the banquet.

NORTH CENTRAL—APRIL 17–19

On April 17, 18, and 19, the North Central Conference of Student Chapters held its spring meeting in Pittsburgh, Pa., where it was sponsored jointly by the Student Chapters of the Carnegie Institute of Technology and the University of Pittsburgh. The North Central Conference covers Ohio and parts of surrounding states, and includes the following Chapters: Case School of Applied Science, Ohio Northern University, Ohio State University, the University of Dayton, the University of Cincinnati, West Virginia University, the University of Michigan, the University of Akron, the Carnegie Institute of Technology, the University of Pittsburgh, Michigan State College, and the University of Louisville. All except the two latter Chapters were represented at the meeting.

The officers for the Conference were John O'Brien, of Carnegie Institute of Technology, president; Charles Sampson, of West Virginia University, vice-president; and John Steketee, of Michigan State College, secretary-treasurer. There were about 60 visiting delegates as well as an equal number from the University of Pittsburgh and the Carnegie Institute of Technology in attendance, making a total of about 120 in all. The out-of-town delegates were housed free of charge in fraternity houses on the campuses of the two schools.

At the Thursday afternoon session Chester Beemer, president of the University of Pittsburgh Chapter, presided. The main addresses were given by George T. Seabury, Secretary of the Society, and J. N. Chester, former Vice-President. Mr. Seabury spoke on the organization of the Society, and Mr. Chester gave advice to young engineers on getting a job.

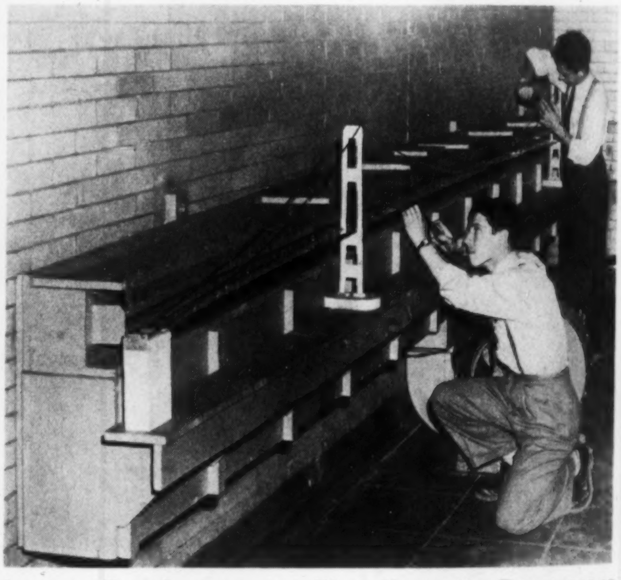
The banquet on Thursday evening was sponsored by the Pittsburgh Section, with Louis P. Blum, president of the Section, acting as toastmaster. Addresses were given by Mr. Seabury—this time on the relationship of the Society to the national defense program—and by Lt. Col. L. D. Worsham, district engineer for the U.S. Engineer Office on the Allegheny County flood control program. Colonel Worsham also showed motion pictures of the collapse of the Tacoma Narrows Bridge.

Ideal weather prevailed on Friday, and an inspection tour of the city went off just as scheduled. A caravan of twenty-five cars with a police escort made the trip. A number of bridges were inspected, and a stop was made for a view of the city from Mt. Washington, one of the highest points in the region. Luncheon was held at the beautiful Alcoma Golf Club in the foothills of the Alleghenies. Following luncheon, Prof. H. A. Thomas, of Carnegie Institute of Technology, discussed Loyalhanna Dam, to be visited in the afternoon. Later, at the dam, the group was shown around by guides furnished by the Corps of Engineers. This concrete, gravity-type dam, located on Loyalhanna Creek near Saltsburg, Pa., is over half completed.

On Friday evening a dance was held in the Pitt Cathedral of Learning. An unusual feature of the evening was a blackout test of the Pittsburgh area arranged by the U.S. Army Air Corps.

The Saturday morning program started off with inspection of the laboratories of the Carnegie Institute of Technology, special attention being given to the Hydraulics Research Laboratory where dam models are tested and perfected for the U.S. Government. At the Carnegie Tech Little Theater, the final papers in the Student Paper Competition were presented, and awards were made by vote of the delegates present. William Froehlich, president of the Carnegie Tech Chapter, presided. As a result of the contest, first prize of $10 went to William Apple, of Ohio State University, for his paper on "Suspension Bridges," and second prize of $5 to George Sowers, of the Case School, for his paper on "Beach Erosion." Fred Feiler, of Carnegie Tech, and Harry Graham, of the University of Cincinnati, received honorable mention.

At the business meeting that followed, changes in the constitution were discussed, and the Pittsburgh Section was given a vote of thanks for its cooperation in arranging the Conference. Cleveland, Ohio, was selected as the site of the next convention in the spring of 1942, and new officers were elected as follows: Robert Clark, of the Case School, president; Robert Mark, of Ohio State, vice-president; and Javier Covarrubias, of the University of Dayton, secretary-treasurer.



CARNEGIE TECH LABORATORIES WERE VISITED BY DELEGATES AT NORTH CENTRAL STUDENT CONFERENCE

PHILADELPHIA—APRIL 20–21

Princeton University acted as host to the Student Chapters of the Philadelphia and Lehigh Valley Sections on the occasion of the

Seventh Annual Conference, which took place on April 20 and 21. Ideal weather favored the gathering, which was attended by about one hundred students, faculty members, and guests.

The Sunday evening smoker, which was inaugurated at the Pennsylvania State College Conference last year, was a feature of this year's Conference, too. Since students from the more distant colleges usually find it desirable to arrive on the evening preceding the Conference, the Sunday evening entertainments are very appropriate; and the show put on by the Princeton Chapter was excellent. Following the entertainment the group visited several classrooms, where scale models of arches and bridges were described. Later the analysis of a rigid-frame mill building was explained by means of a scale model and the Beggs deformeter.

On Monday morning an inspection of the various laboratories and the campus was made prior to the meeting proper. At ten o'clock the group gathered in the engineering lounge, where they were welcomed by Prof. Philip Kissam, acting chairman of the civil engineering department at Princeton University. Prof. Scott B. Lilly responded for the Philadelphia Section, and he was followed on the program by Prof. Howard K. Preston, chairman of the Committee on Student Chapters of the Philadelphia Section.

The student contest papers were next presented and consisted of the following subjects: "Flood Control in Sunbury, Pennsylvania," by Glen U. Rothermel, of Bucknell University; "Foundations for the Ocean Drive," by William L. Weller, of Drexel Institute; "Construction of Landing Fields and Runways for Airports," by Michael C. Gallo, Jr., of Lehigh University; and "Preliminary Study of the Application of Electric Resistivity Strain Gages to Tests on Model Piles," by John E. Krome, of Princeton.

Next, the group were guests of the Section and the Chapter at Madison Hall, a student dining room on the campus. After luncheon, Dr. Kenneth A. Condit, dean of the school of engineering at the university, gave an address on "The Engineer's Place in National Defense." Then the board of judges, consisting of Charles S. Shaughnessy, Howard T. Critchlow, and Harold O. Hill, announced the winners of the student awards.

First prize of $20 in cash and $20 to be paid for entrance fee and Society dues, went to Mr. Krome; second prize of $20 for entrance fee and Society dues to Mr. Weller; and third prize of $10 for entrance fee or Society dues to Mr. Rothermel. The latter award is given by the Lehigh Valley Section.

The meeting was then adjourned with the announcement that the next convention would be held at Bucknell University in 1942. In all the meeting was very successful, and the Princeton group is to be congratulated on a well-planned Conference.

SPRING MEETING CONFERENCE—APRIL 23–24

On April 23 and 24 the Johns Hopkins University Student Chapter was host at a Conference of Student Chapters held in Baltimore in conjunction with the Spring Meeting of the Society. Registration of delegates started at 9 a.m. on Wednesday morning. There were 129 students representing the following universities: Agricultural and Mechanical College of Texas; the Catholic University of America; Clemson Agricultural College; Duke University; George Washington University; the Johns Hopkins University; North Carolina State College; the University of Illinois; the University of Maryland; and Virginia Military Institute.

At 10:00 a.m., G. J. Bauer, president of the Johns Hopkins Student Chapter, called the meeting to order in Latrobe Hall, the civil engineering building of the host college. Dr. Isaiah Bowman, president of the university, welcomed the visiting students to the Conference and wished them a successful meeting. Following Dr. Bowman's address of welcome, a short talk was given by Walter E. Jessup, Field Secretary of the Society, who stressed the need for young civil engineers in the existing national emergency.

A discussion of the main topic of the day—a proposal for strengthening the existing bond between the Student Chapters and the Society—was then begun. The proposal is to be studied in more detail by the Student Chapters at their local meetings. Then Dr. Ralph Lee, of the General Motors Corporation, delivered the principal address of the morning on "The Care, Feeding and Rearing of an Infant Industry."

At noon the Conference adjourned for luncheon at Levering Hall on the campus. After luncheon, the students posed for the accompanying photograph and then left by bus for an inspection trip to the assembly plant of the Chevrolet Motor Company, where they witnessed the mass production methods so characteristic of American industry.

In the evening there was a banquet at Levering Hall, at which the toastmaster, Dr. Abel Wolman, introduced the faculty members and others guests of the Conference. Representatives of the various Chapters spoke briefly, expressing their complete satisfaction with the occasion. Then Henry C. McComas, former professor of psychology at Johns Hopkins, gave an address on "Ghosts I Have Talked With," in which he told of his experiences in exposing the seemingly supernatural events that accompany seances. Later the students joined the members of the Society at their dance held in the Lord Baltimore Hotel.

On Thursday morning, April 24, the students had the alternative of attending the technical sessions of the Society or going to the exhibits at the Maryland Academy of Sciences prepared especially for the Conference. A special feature at the latter was a demonstration of geodetic surveying conducted from the observatory on the roof of the building. In the afternoon the students entrained with members of the Society for the trip to the Safe Harbor and Holtwood hydroelectric plants on the Susquehanna River. Supper was served on the tailrace bridge of the Safe Harbor Water Power

DELEGATES AT SPRING MEETING STUDENT CONFERENCE

Corporation, and entertainment and refreshments were provided on the train during the return trip to Baltimore.

VIRGINIA—APRIL 26

The annual Conference of Student Chapters in Virginia was held at Lexington, Va., on April 26, with the Chapter at Virginia Military Institute acting as host. There was a good representation from the visiting Chapters—14 from Virginia Polytechnic Institute and 11 from the University of Virginia, in addition to the entire junior and senior classes from Virginia Military Institute.

After registration the meeting was opened with a short address of welcome by Gen. James A. Anderson, head of the department of civil engineering at Virginia Military Institute. The meeting then continued with a number of student papers, each school being represented by two speakers. W. H. Lewis and W. E. Cline, of the Virginia Polytechnic Institute, discussed "Kellogg Health Games," and "City Management," respectively. Speakers from the University of Virginia were E. Boyd Livesay, whose subject was "The Multiplex Method of Mapping from Aerial Photographs," and David Schumaker, who discussed "Soil Stabilization by Portland Cement." Defense topics were selected by the speakers from Virginia Military Institute. Stanley Navas spoke on "Defense of Our Caribbean Bases," stressing mainly the importance of the Caribbean bases to keep the Panama Canal open until the United States can build up a two-ocean navy. A scheduled talk by Alvin Meyer on "Emergency Chlorination of Bombed Water Supplies" was not given because of lack of time.

At the close of the student talks R. V. Jacobs, president of the Virginia Military Institute Chapter, introduced E. M. Hastings, chief engineer of the Richmond, Fredericksburg and Potomac Railroad and contact member for the local Chapter. Mr. Hastings' subject was the "Duties and Opportunities of the Young Engineer in Connection with National Defense." According to him, the young engineer has more opportunities today than ever before, a situation brought about chiefly by specialization and defense work. He also stressed the necessity for serious thinking and intelligent action on the part of the youth of today.

After the speeches were completed, the group was invited to meet at Virginia Polytechnic Institute in the spring of the coming year. The visitors were entertained both before and after the meeting, witnessing a regimental parade by the local cadet corps in the morning, and attending a tea dance in the afternoon. They also enjoyed a luncheon in the Virginia Military Institute Mess Hall.

Meeting of Board of Direction—Secretary's Abstract, April 21-22, 1941

THE BOARD met at the Lord Baltimore Hotel, Baltimore, Md., on Monday and Tuesday, April 21 and 22, with President Frederick H. Fowler in the chair, and Secretary Seabury and the following members of the Board in attendance; Past-Presidents Sawyer and Hogan; Vice-Presidents Jacobs, Lucas, Burdick, and Stevens; and Directors Blair, Bres, Brooks, Carey, Cunningham, Dunnells, Goodrich, Howard, Hudson, Hyde, Leeds, Lewis, Massey, Polk, Requardt, Sawin, White, and Wiley—a full attendance except for Director Cowper, who was ill.

In Memory of Treasurer Hovey

The Board stood for a moment of silence in respect to the memory of the late Dr. Otis E. Hovey, Honorary Member and Treasurer of the Society. The President was authorized to appoint a committee to draft a resolution of tribute, which committee later reported in the form given elsewhere as a separate item.

By-Laws Amended—Article IV. "Committees"

Following due notice of a proposed amendment, Article IV of the By-Laws—"Committees" was amended as to Section 11 by eliminating reference to the Committee on Public Information and all of paragraph (*b*) dealing therewith; and relettering the following paragraphs (*c*) to (*f*), inclusive, making them (*b*) to (*e*), respectively.

Local Section Constitutions

Approval was given to the Mohawk-Hudson Section to amend its constitution and By-Laws; and to the Nebraska Section to adopt a revised constitution.

Special Committee, Stresses in Railroad Track, Discontinued

Approval was given to the discontinuance of the Society's Committee on Stresses in Railroad Track, under the chairmanship of Arthur N. Talbot, Past-President and Honorary Member, with a sincere vote of thanks. This action coincided with similar action of the American Railway Engineering Association, cooperating in this research work. A separate item elsewhere gives the details.

Appointment of Officers

In accordance with the By-Laws, selection of appointive officers was considered. Both George T. Seabury, as Secretary, and Ralph R. Rumery, as Assistant Treasurer, were reappointed. In the case of the treasurership, as successor to the late Dr. Hovey, Charles E. Trout, M. Am. Soc. C.E., was appointed, and he later indicated acceptance of this action.

Mr. Trout was designated as one of the Society's representatives to the United Engineering Trustees, Inc., for the unexpired term of Dr. Hovey.

Joint Engineering Efforts in Washington

Following report and recommendation from the President, the Board, after discussion, decided to cooperate in a joint engineering society office in Washington, as covered by the following resolution:

"WHEREAS, American Engineering Council which heretofore afforded a medium for some measure of joint action by the engineering bodies of the country was dissolved on January 1, 1941, and

"WHEREAS, a national defense emergency now exists that calls for a definite measure of solidarity and concurrent action involving representation at Washington of the four Founder Engineering Societies,

"*Therefore be it resolved*, that the Society cooperate with the other Founder Societies in establishing a joint office in Washington, staffed by a competent woman, equipped with telephone, and with desk space for any special representative that each society may have in Washington; and

"*That* the Society cooperate with the other Founder Societies in establishing a Joint Conference Committee, consisting of the president and secretary of each society, to meet at least quarterly, to consider joint efforts in national defense and other matters to improve the solidarity of the engineering profession."

Appropriation was made "sufficient to commit the Society to its proportionate share in the expense of the proposed office for the remainder of 1941, but not to exceed the period of duration of the national emergency."

Representation in Washington

The Board also designated Field Secretary Walter E. Jessup to act as local representative of the Society, with residence in Washington.

Qualifications for Transfer, Junior to Associate Membership

Through the Committee on Membership Qualifications, a suggestion was made for clarifying the regulations so as to better provide for the retention of Juniors in the Society after they reach the constitutional age limit of 33 years. After extensive discussion, the following ruling was adopted:

"In the case of Juniors who have reached the age of 33 and who have application on file for transfer to the grade of Associate Member the Membership Qualifications Committee, in its judgment, may deem such applicants as having had 'responsible charge of work as principal or assistant for at least one year' when the applications record all the provisions under either (1) or (2) as follows:

1. *Graduates*
   - (*a*) Graduation in an engineering curriculum accredited by E.C.P.D.
   - (*b*) A progressive and continuous record since graduation, or at least 8 years of engineering experience.
   - (*c*) Demonstration of aptitude for future development as an engineer.
   - (*d*) Approval by the Local Membership Committee, employer, and Corporate Member references.
   - (*e*) A statement by employers that applicant has been entrusted with, and has had responsible contact with, work of some magnitude and importance.

2. *Non-Graduates*
   (a) Twelve years' progressive and continuous engineering experience.
   (b) Demonstration of aptitude for future development as an engineer.
   (c) Approval by the Local Membership Committee, employer, and Corporate Member references.
   (d) A statement by employers that applicant has been entrusted with, and has had responsible contact with, work of some magnitude and importance."

1942 Society Meetings—Annual Convention in Spokane

Responding to a cordial invitation from the Spokane Section, the Board voted to designate that city for the 1942 Summer Convention, probably in July. Previously the 1942 Spring Meeting had been assigned to New Orleans, La., in response to an invitation from the Louisiana Section.

Charter of United Engineering Trustees, Inc.

Report was received from the Committee on Society Relations, following whose recommendation the Board endorsed a proposed amendment to the charter of the United Engineering Trustees, making provision for proper planning of future housing for the Founder Societies.

Accrediting Program of E.C.P.D.

Responsive to recommendation of the Committee on Engineering Education, the Board's position was reaffirmed in recommending that E.C.P.D. limit its accrediting of undergraduate engineering curricula to those of civil, chemical, electrical, general, mechanical, and mining and metallurgy.

Committees' Reports

Reports were received from the following committees, among others: Publications Committee, regarding general status of its work, particularly proposed manuals; Membership; and Professional Conduct, with six matters covered in detail. In addition, other committees offered reports of more routine character.

Miscellaneous Matters

Various matters of administrative, financial, or organizational detail were reported, with appropriate action in each instance.

Adjournment

The Board adjourned to meet at San Diego, Calif., on Monday, July 21, 1941.

Society Aids in Salary Survey for Nebraska State Engineering Employees

Increased salaries for the State Engineer and other engineers in the Department of Roads and Irrigation were recommended in a report to Governor Griswold of Nebraska, on April 23, 1941. This was the third report of a similar nature made during the past year by representatives of the Society, in accordance with a plan approved by the Board of Direction.

The Nebraska report was the result of a seven weeks' study by Allen P. Richmond, Jr., M. Am. Soc. C.E., Assistant to the Secretary, at Society Headquarters. It was made at the request of the Nebraska State Engineer, Wardner G. Scott, Assoc. M. Am. Soc. C.E., and under the supervision of Dean Thomas R. Agg of the Iowa State College of Engineering, a former Director of the Society.

The report contained a proposed series of seven professional and four subprofessional grade specifications; recommendations that job descriptions and a merit rating system be devised and adopted; a plan for instituting salary ranges commensurate with the grades; and the recommended salary ranges themselves.

Approximately 325 engineering employees would be affected by the proposed increased salary schedule during the off construction season. When construction is at its peak, it is probable that this number will be increased to about 550.

Under the present law, the State Engineer's salary may not exceed $6,000, and according to the report "it may be stated flatly that this salary is too low." The report recommends that the State Engineer's salary be not less than $7,500 and not more than $9,000.

The following is quoted from a Nebraska newspaper article:

"The report pointed out that the State Engineer's position requires 'professionally recognized qualifications and leadership of a high order to direct successfully . . . work involving the expenditure of more than $10,000,000 a year. The kind of leadership and capabilities required for the position of State Engineer of Nebraska are such that this should be considered an $8,000 or an $8,500 job.'

"Pointing to the losses of personnel in the department, due to higher salaries elsewhere, the report said that replacements are becoming increasingly hard to find, because of the defense program, and urged immediate steps to halt such resignations.

"The report states that in the past 15 months, 104 members of the engineering personnel have resigned, mostly to get better paying jobs elsewhere. 'A number of others are known to be considering such transfers but have deferred making their decisions until they can see what improvements will result from this survey.'

"What action would be taken on the recommendation for salary increases was not known. The recommendations for the use of grade specifications and a merit rating system will be put into effect, State Engineer Scott said.

"Grade specifications will be used to classify the various positions in the department in accordance with requirements for proper performance and also to rate individuals as to their ability to perform engineering jobs

"The specifications for each position will be drawn up by the State Engineer's office and then each engineer in the department will be rated according to these detailed specifications. The two will be correlated."

The general plan recommended for the department to follow in such a reorganization is as follows:

1. Adopt grade specifications
2. Write job descriptions
3. Assign positions to grades
4. Devise and adopt a merit rating system
5. Prepare a new, more complete service record card
6. Make ratings of engineers
7. Re-rate all employees at intervals of about one year

Copies of the report may be obtained from State Engineer Wardner G. Scott, Lincoln, Nebr.

Sedimentation and Hydraulic Structures Studied in the South

Moving away from the east coast toward the South and West, Haywood G. Dewey, the Society's Freeman Scholar for 1940–1941, has visited the Enoree River Sediment Station of the Soil Conservation Service at Greenville, S.C., and many of the hydraulic works of the Tennessee Valley Authority. His interpretation of the developments witnessed should be of general interest.

The Enoree River Station was developed to obtain quantitative measurements of the total sediment load of a stream actually large enough to be representative of rivers in general. In an effort to include all aspects of the problem, investigations will be made for determining (1) the relation of the character and amount of sediment load to the hydraulic and physical characteristics of the stream, (2) the relation between the properties of the watershed and the amount and composition of the total sediment load, (3) a practical and simple method of estimating the total sediment load, and (4) methods of controlling the load in actual streams.

Approximately 100 ft of the Enoree River has been paved with concrete and straightened with vertical retaining walls. Measurements of the amount of bed load and suspended load can be made within this control structure. The bed load moving along the bottom of the lower end of the control structure passes across 14 openings separated by vertical vanes. Each opening is connected through a header to a pump on the right bank. The pump removes the bed load as it flows over the opening and disposes of it in a settling tank from which it is eventually removed for weighing and analysis. Suspended load is simultaneously checked by samplers located at a point immediately downstream from the bed-load opening.

Continuous records have been taken only since January 1939, but results so far indicate that definite relations exist between sediment load and discharge for the coarser materials but not for the finer materials.

The hydraulic laboratory of the Tennessee Valley Authority in Norris, Tenn., is devoted to problems of structural design related to navigation and soil development. This laboratory and similar ones, such as the U. S. Waterways Experiment Station at Vicksburg, Miss., and that of the Bureau of Reclamation at Denver, Colo., are necessarily limited to experiments that are practical in contrast to the academic research usually found in universities.

With the exception of the Norris and Wheeler dams, all the more modern structures in the Tennessee Valley have been model-tested as a check on safety and economy. Dams of the type employed on rivers like the Tennessee and Mississippi present problems not usually found in connection with structures designed primarily for flood control and power development.

The problem of energy distribution below the spillway is particularly critical. At dams in navigable rivers, the hydraulic jump may not be obtainable because of the excessive tailwater required for navigation. Laboratory tests at Norris are therefore made more difficult and demand considerable resourcefulness in the development of satisfactory solutions.

Aeration of overflow nappes, on the other hand, is a problem common to spillway structures of all kinds. The Norris Laboratory encountered the problem in connection with the double-leaf slide gates used on the Chickamauga, Guntersville, and Pickwick Landing dams. As water may flow between the gate leaves or over the lower leaf, a region of sub-atmospheric pressure forms under the nappe between adjacent piers and increases the total pressure acting on the gate. Although it is known that aeration instantly relieves this pressure, the question of air demand is one that has had to be solved in the laboratory. It is interesting that field tests have checked the laboratory curves quite closely.

At present there are two methods of testing models of outlets for cavitation. One method reduces the atmospheric pressure in the model according to the scale ratio, if possible, and causes cavitation. With the other method the model outlet is tested under normal atmospheric pressure, and the prediction of cavitation in the prototype is based upon a proper conversion of values. The latter method, which is used in the Norris Laboratory, is much simpler and is more generally used elsewhere.

Assistant Secretary Beam Becomes Lieutenant Commander in Active Naval Service

ANOTHER of the Society's staff has been called into active service for war work—C. E. Beam, Assistant Secretary, formerly Reserve Officer, who has been made a Lieutenant Commander in active service. He reported to the Bureau of Yards and Docks in Washington on May 19. A similar call of Maj. Donald P. Barnes into Army service is noted elsewhere in this issue. While Mr. Beam was the oldest of the technical staff in point of Society service, Mr. Barnes was the youngest.

It was in the fall of 1921, during the Secretaryship of E. M. Chandler, that Mr. Beam entered the service of the Society. Shortly he was made Assistant Secretary. As the only engineer assistant on the staff, he handled a variety of matters, but primarily his work was in connection with the technical publications. Since then, with the expansion of Society activities, he has devoted himself entirely to other specialized features.

CARL E. BEAM, LIEUTENANT COMMANDER, C.E.C., U.S.N.

All the Society meetings, with the tremendous amount of correspondence and planning that they entail, have been directly in his hands. Along with this, the administration of the Technical Divisions, an activity that has been growing by leaps and bounds, has centered in his office. He has been the Society's representative on the Engineering Societies Personnel Service and has assisted the Board's Committee on Securities.

He conducted numerous and extensive studies prior to the establishment of the Retirement System for Employees; he then became member and secretary of the committee handling this work. Anyone coming to Headquarters with a problem, by phone or in person, has found a ready listener in Mr. Beam. As the principal contact man, he has been always ready to assist—with advice, information, or reference to a direct source of help. In this way many members have come to know him and trust his judgment. Through these and other associations he has made for himself a wide circle of genuine friends.

On the occasion of his departure, his friends in the office staff presented him with a wrist watch, suitably engraved, on Wednesday, May 14. At noon his technical and administrative associates tendered him a farewell luncheon at the Engineers' Club.

As a result of his 20 years of unceasing work at Headquarters, he carries with him nothing but good wishes for his war work.

Charles E. Trout, New Treasurer of the Society

BY UNANIMOUS vote of the Board of Direction at its Baltimore meeting, Charles E. Trout, M. Am. Soc. C.E., was elected Treasurer of the Society. He succeeds Dr. Otis E. Hovey, Hon. M. Am. Soc. C.E., recently deceased.

Although born in Ontario, Mr. Trout received his technical schooling in the U.S., being graduated from the Massachusetts Institute of Technology in 1896. For 40 years his experience has been entirely in New York City and almost exclusively in connection with waterfront construction. For 17 years, with one short intermission, he was with the department of docks and ferries. The World War interrupted this connection but did not change the nature of his work—he took charge of design and construction of the waterfront structures at the Brooklyn Army Supply Base. Since that time he has been in private employ, including consulting engineering on harbor problems. At present he is the New York Division Manager of the Great Lakes Dredge and Dock Company.

CHARLES E. TROUT, SOCIETY TREASURER

Always vitally interested in Society affairs, Mr. Trout served a term as Director for the years 1934–1937. He has been active in local Society matters. Of particular interest is the fact that he has served as treasurer of the Metropolitan Section.

Those in charge of Society administration have come to recognize in Mr. Trout a man of industry, ability, and integrity. The duties of the Treasurer, which have fallen in succession to a notable list of appointees, continue to rest in conscientious hands as Mr. Trout assumes the office, effective April 21, 1941.

Last Call for Mead Prize

THOSE Juniors or Students who are planning to enter the Mead Prize competition for the current year should proceed without delay. The time limit is July 1, and a number of formalities have to be complied with.

For the coming year the student prize paper is to be written on the subject of "Ethics of the Engineering Inspector," while

Juniors will submit their ideas on "Ethics of Junior Construction Engineers." Reference should be made to the Yearbook, page 120, for complete details. Limited time remains for meeting all the requirements.

"There All the Honour Lies"

For his speech accepting the award of Honorary Membership at the Annual Meeting of the Society in January, Col. F. G. Jonah arranged a sequence of quotations from Shakespeare and others on the subject of honor. This group of delightful and appropriate excerpts throws light on an attribute that is the engineer's richest heritage. Quoting Colonel Jonah:

"Now that I am joining the company of the 'Elder Statesmen,' may I take a line from *Julius Caesar* as a text:

> Well, honour is the subject of my story

"To the engineer, honor is all-important, as it is the very foundation of his code of ethics.

"If we want to find out how men regard honor—their different conceptions of it—we need only to consult Shakespeare, as he has expressed every thought, sentiment, and emotion that mankind has ever experienced, and we find that much has been said by the famous characters in his plays on this theme.

"Falstaff has a soliloquy on honor. When the Prince of Wales, afterwards the great King Henry V, was making preparations for the battle of Shrewsbury, Falstaff, loath to go, said:

> Honour pricks me on.
> Yes, but how if honour pricks me off when
> I come on,
> How then?
> . . . .
> Is it insensible, then? Yea, to the dead.
> But will it not live—with the living? No.
> Why? Detraction will not suffer it.
> Therefore I'll none of it.
> Honour is a mere scutcheon.

"That is honor as viewed by one utterly devoid of it in every respect. There is in it an element of truth in that honor does not live with the living because detraction will not suffer it. This is sometimes the case. There must have been detractors in Shakespeare's time—they are called "debunkers" today and they are numerous and busy.

"But over and against Falstaff's view, take this from *King Richard II:*

> Mine honour is my life; both grow in one;
> Take honour from me, and my life is done.

"In *Othello* there are many references to honor and we find this strange line:

> But why should Honour outlive Honesty?

"It is, I think, a laudable and worthy ambition to seek honor, and King Henry V, whose career as Prince of Wales was not very honorable, yet attained great honor when confronted with the responsibilities of kingship, said:

> But if it be a sin to covet honour,
> I am the most offending soul alive.

"We have all known, I am sure, many humble people whose characters were ennobled by a fine sense of honor. Shakespeare recognizes this in these lines from *The Taming of the Shrew:*

> And as the sun breaks through the darkest clouds,
> So honour peereth in the meanest habit.

"There may be times in an engineer's career when he is tempted to or urged to take some line of action not in harmony with his code of ethics, and in such a case this line from *Hamlet* may well be heeded:

> Weigh then the loss your honour may sustain.

"It is encouraging to know that honor is within the reach of everyone. Alexander Pope, who made the wise observation that the proper study of mankind is man, also said:

> Honour and shame from no condition rise,
> Act well thy part; there all the honour lies.

"The members of our profession are characterized in the main by honesty, industry, and ability, and these qualifications lead to honorable careers. If a man reaches the period when it may be said of him that:

> He wears his blushing honours thick upon him

and can look back upon a record of more than half a century of continuous activity in the profession, I am sure that his life will have been a most satisfying one, made up doubtless of some adventures, some successes, and some failures—and we sometimes learn much from our failures—some disappointments, and in some cases an experience similar to that summed up by Hilaire Belloc in a couple of lines:

> Laughter and memories, and a few regrets,
> Some honour, and a quantity of debts.

Howard F. Peckworth Becomes Editor of "Civil Engineering"

Effective May 19, Howard F. Peckworth, M. Am. Soc. C.E., became editor of Civil Engineering, succeeding Donald P. Barnes, Assoc. M. Am. Soc. C.E., recently assigned to Army duty.

Howard F. Peckworth,
M. Am. Soc. C.E.

Mr. Peckworth comes to the Society after fifteen years of excellent experience on a variety of engineering construction projects. His taste for engineering journalism is attested by a number of articles in Civil Engineering as well as discussions in Proceedings and Transactions.

After graduation from Princeton University in 1926, Mr. Peckworth spent a number of years on subway and foundation work around New York City, being connected with transit construction in Queens, in Brooklyn, and in Manhattan. There followed a year on the construction of the Tygart Dam in West Virginia, over two years as resident engineer on earth and rock-fill dam and reservoir work in Alabama, a short period as plant designer with the contractor on Shasta Dam, California, and two years with the PWA as senior engineer (soil mechanics and foundation expert) on the $50,000,000 Santee-Cooper Project in South Carolina. This latter work was composed of North Santee hydraulic-fill dam, Santee concrete spillway dam, Pinopolis Dam, lock, and power house, Pinopolis tailrace, and Cooper River Improvement, as well as 25 miles of low dikes.

In his new work it is expected that Mr. Peckworth will put to good use his wide acquaintance with engineers and with engineering work throughout the country. With Mrs. Peckworth and his two children, he expects again to take up residence near his old home in Ridgewood, N.J.

Appointments of Society Representatives

Charles B. Burdick, M. Am. Soc. C.E., represented the Society on the occasion of the presentation of the Washington Award to **Ralph Budd**, M. Am. Soc. C.E., in Chicago on February 24.

William H. Richards, Jr., M. Am. Soc. C.E., has been appointed to represent the Society on the Advisory Council of the Federal Board of Surveys and Maps, to fill the vacancy caused by the death of **William Bowie**, M. Am. Soc. C.E.

Charles E. Trout, M. Am. Soc. C.E., has been appointed one of the Society's representatives on the United Engineering Trustees, Inc., to fill the unexpired term of the late **Otis E. Hovey**, Hon. M. Am. Soc. C.E.

Progress by Committee on Civilian Protection in War Time

By WALTER D. BINGER, M. Am. Soc. C.E.
Chairman, Society's National Committee on Civilian Protection in War Time

PREVIOUSLY in these columns information has been broadcast to the membership regarding the activities of the Society's National Committee on Civilian Protection in War Time, including the local extension of this work by the appointment and active cooperation of parallel committees in the Local Sections. I have now been requested briefly to bring the record up to date.

For several months after organization of the Section's committees, it was felt by some that there was insufficient information available to enable the Section committeemen to do effective work. This was astonishing to the National Committee. It will be recalled that questions in each of the divisions into which the National Committee is divided were prepared by them in January and taken to England by a group sent over by the Federal Government. Simultaneously the questions were distributed and each Section committee was asked to give information respecting anything its members might know about the engineering aspects of civil protection in England. None claimed to have such knowledge. It was practically non-existent in this country four months ago.

A great step in advance was thus made when the National Technological Civil Protection Committee (on which the Society is represented by the writer as chairman) published last month "Authentic Information Secured in Britain by American Observers, Principally Based Upon Questions Prepared by This Committee." Briefed all over the country by the daily press, a demand for hundreds of copies has been received from industrial and public service companies, libraries, colleges—even from Canadian sources.

It gives information of first-rate importance on effects of bombs on a variety of structures—bridges; water supply, gas and electric distribution facilities; communications; and so forth. This document has to a great extent added a foundation of basic, though somewhat scattered, information applicable to some of the most important phases of passive protection. It can be said without fear of contradiction that this information would not have been secured but for the questions with which the relatively untrained visitors to England were armed.

Perhaps of greater importance than the foregoing is the publication by the War Department a few weeks ago of "Protective Construction," which, on its title page, bears the statement, "Prepared under the direction of the Chief of Engineers, U.S. Army, with suggestions of the National Technological Civil Protection Committee." This booklet is of paramount interest to civil engineers and a copy has been distributed to each of the approximately 300 members of the Section committees. It is well illustrated with plans of shelters and other details. The work of correction in this case was done entirely by the civil engineers.

Of universal interest is the pamphlet on "Defense Against Gas" now in the hands of the printer, produced by similar collaboration, except that the burden of criticism was shared by the American Institute of Chemical Engineers, the American Society of Heating and Ventilating Engineers, and the American Society of Civil Engineers. It is a fine example of cooperation between the War Department and these three groups. Its publication is expected shortly. The writer now has in his possession a first rewrite of the draft of the War Department's proposed publication, "Manual on Fire Protection for the Defense of Civilian Population," while the one on "Blackouts" has just been received.

All of the material received by the Sections in April and May has been augmented by the valuable new communications sent out by the national committeemen, the most important of which in this period were probably those of Prof. Charles B. Breed, of Boston, the national committeeman on transportation. This included a sample map showing a typical alternate route of existing highways parallel to an obvious military highway. The Transportation Division committees throughout the country have been given the problem of working out two such routes for the cardinal points through their respective Section areas.

In June there may be expected a valuable and largely original descriptive outline of a technical bulletin on the Sanitary and Public Health Engineering Division's work. It has been prepared by Samuel A. Greeley of Chicago, the national committeeman for that division.

The flow of ideas has not in any sense been one way. The national committeemen have received suggestions, information, and reports on local conditions from their corresponding members on the Section committees.

May 15, 1941

Defense News

TREMENDOUS quantities of lumber have been bought for cantonments since the Defense Construction Program began. Estimates of the combined purchases of the Army and the contractors directly engaged to build these cantonments reached nearly two billion board feet. That these purchases do not constitute a large part of the annual production of lumber can be seen by comparison with 27 billion board feet of lumber produced in 1940; and with an average annual production over the last four years of 23 billion board feet.

Sharp price increases in lumber last fall because of Army demands have been headed off and stabilized by preparing stock piles for future needs. The Army agreed to purchase one-quarter billion board feet, one-half to be delivered by May 1. It is reported that mills are on schedule with the production of this order.

* * * *

Topographic maps of some of the most vital areas in the coastal and border defense plans of the United States are now being revised for technical use by WPA workers under the supervision of the Army Corps of Engineers. Covering an area aggregating over 200,000 sq miles along the eastern seaboard, the Great Lakes states, the Mexican border, and the west coast, the maps will show natural and artificial features of the landscape on a scale of approximately one inch to the mile.

* * * *

Government economists have raised their prediction of the national income in 1942 from $90,000,000,000 to $100,000,000,000 because of the acceleration of the defense program and the effect of the Lease-Lend Act. This indicates a combined naval, military, overseas, and civil demand for steel of over 110 million tons next year. This expected demand tops the present reliable annual productive capacity of the American steel industry by 20 million tons. Today the industry is producing at the rate of 85 million tons annually. Strict priorities, curtailment of civil requirements, and steel plant expansion are expected to be necessary.

* * * *

The President signed, on April 30, a bill making another $150,000,000 available for Defense Housing. This will provide for approximately 35,000 more dwelling units for civilian defense workmen and their families who are concentrating at industrial centers.

Up to May 1, 56,000 dwelling units had been approved. On that date, 40,600 units were under contract estimated to cost $120,000,000, and 3,700 had been occupied. The building of portable houses, prefabricated demountable houses and dormatories has begun and the purchase of an obsolete passenger ship is contemplated.

The Defense Housing Program is divided among the following government agencies: Bureau of Yards and Docks of the Navy; the U.S. Housing Authority; the Public Buildings Administration; the Federal Works Agency; the Tennessee Valley Authority; and the Farm Security Administration.

* * * *

Bills to provide community facilities made necessary by the defense program have been introduced in both Houses of Congress. The bills carry authorization to appropriate $150,000,000 for the acquisition and equipment of such community facilities as schools and hospitals, sewerage and water systems, recreational facilities, and streets. Broad powers would be granted under the bill to the President to make determinations, with respect to any locality, that an acute shortage of public works or equipment for public works necessary to the health, safety, or welfare of persons engaged in national defense activities exists or impends, which would impede national defense activities; and that such public works or equipment cannot be provided locally or otherwise.

The Federal Works Agency, or other government agency the President may designate, would be charged with administration of the program and be authorized to make loans or grants or both for construction; or to make contributions to public or private agencies for the maintenance and operation of public works.

* * * *

With the award of cost-plus-fixed-fee contracts to engineering firms in private practice, the Construction Division of the Quartermaster Corps has begun the preliminary surveys and plans for 28 large camps, cantonments, and required replacement training centers and anti-aircraft firing centers. Plans are to be completed in 90 days ready to award construction contracts. Each of these camps will accommodate about 35,000 men, and the camps are estimated to cost about 23 million dollars.

After a three months' study, nine sites have been selected, located near the following communities: Blackstone, Va.; Augusta, Ga.; Neosho, Mo.; Fort Smith, Ark.; Columbus, Ind.; Santa Maria and Lompoc, Calif.; Medford, Ore.; Eugene, Ore.; and Cookson Hills, Okla.

This program is to forestall the contingency that training facilities may be needed for additional troops and that Congress should decide to authorize an increase in the Army. At this time no land is to be acquired, nor has money been authorized for construction. Each site will contain 50,000 to 75,000 acres.

* * * *

The Office of Production Management recently announced that up to the end of March the Government had committed itself to pay for 1.9 billion dollars of new factory construction—plants and machinery—to turn out planes, machine tools, tanks, guns, and other defense equipment. This sum does not include the billions of dollars of industrial facilities which were already established and are now at work on defense orders. Of the new plants, 330 have received direct Government funds; 900 more are being built with private funds assuring repayment by the Government during a 5-year period.

* * * *

In preparation for summer Army maneuvers, an immediate program of access road construction for 30 training areas and firing centers, to cost 2.6 million dollars, has been ordered.

* * * *

On the Construction Advisory Committee of the Construction Division of the Quartermaster Corps, Maj. Gen. William D. Connor has been appointed chairman to succeed Brig. Gen. George R. Spalding, who has retired from the committee for reasons of health. This committee passes on the qualifications of engineers and contractors who are needed to assist in carrying out the defense construction program.

* * * *

Of the 100,000 reserve officers in the Reserve Corps of the Army, 44,000 are now on active duty. On completion of their R.O.T.C. courses, and graduation from college, 8,000 young student officers will be commissioned as second lieutenants in the U.S. Army. Another 10,000 will be commissioned from the Officers Candidate Schools which have been set up for enlisted men and warrant officers.

* * * *

The U.S. Civil Service Commission has announced open continuance examinations in all fields of engineering. Application forms may be obtained at any first- or second-class post office. The application, when properly filed, is rated immediately. Applicants rated eligible may be certified at once to an appointing officer and may be tendered an offer of employment by wire. Applicants may be at work within a week of the time of filing application. Aeronautical training is especially in demand, although much of the work now being done also requires the services of qualified civil, mechanical, and electrical engineers.

National Congress—Surveying and Mapping

A NATIONAL congress on surveying and mapping will be held in Washington, D.C., June 16 to 18, 1941. Among other cooperating agencies is the Surveying and Mapping Division of the Society. This is said to be the first unified national gathering of those engaged in this large field. Sessions will be held in the auditorium, Department of Commerce Building, and all members are cordially invited.

News of Local Sections

Scheduled Meetings

COLORADO SECTION—Picnic with the Wyoming Section at Fort Collins on June 9, at 2 p.m. (date subject to change).

PHILADELPHIA SECTION—Outing on June 10, at 2 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:10 p.m.; dinner meeting of the Junior Forum at Hart's Restaurant on June 11, at 6 p.m.

SAN FRANCISCO SECTION—Dinner meeting at the Engineers' Club of San Francisco on June 17, at 5:30 p.m.

TENNESSEE VALLEY SECTION—Dinner meeting of the Chattanooga Sub-Section at the Ross Hotel on June 10, at 5:45 p.m.; dinner meeting of the Knoxville Sub-Section at the S & W Cafeteria on June 10, at 5:45 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Dallas Athletic Club on June 2, at 12:10 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on June 9, at 12:15 p.m.

TOLEDO SECTION—Dinner meeting at the Toledo Club on June 4, at 7 p.m.

WISCONSIN SECTION—Evening meeting at the Knickerbocker Hotel on June 18.

Recent Activities

ARIZONA SECTION—*Tucson, May 3:* An unusually successful spring meeting was held on this date. During the morning business session it was decided to buy membership for the Section in both the Tucson and the Phoenix Chambers of Commerce, as it was thought that such procedure would give the engineering profession direct contact with the civic affairs of these cities. The noon joint luncheon with the Tucson Engineers Club was very well attended, and there was an exceptional turn-out from the University of Arizona, the whole Student Chapter being present en masse. The entertainment at the luncheon consisted of the showing of Kodachrome views of hydraulic structures and scenic views of the state of Arizona. The films and lecture were presented by John H. Gardiner, district engineer for the U.S. Geological Survey. The afternoon technical session, held at the University of Arizona, consisted of a paper on "Airport Planning" by Lt. Col. Edwin C. Kelton, district engineer for the U.S. Engineer Office at Los Angeles, and one on the Gila Project by L. J. Foster, construction engineer for the U.S. Bureau of Reclamation at Yuma, Ariz. Miss Jane Rider, state director of the National Youth Administration, then gave a report on the activities of that organization in Colorado. Dinner and an evening session at University Commons were also well attended. The Section prize of membership in the Section went to Donald Paul Armstrong, and another student—Alexander Knight, of the University of Arizona—presented a paper on the Pennsylvania Turnpike. Charles T. Leeds, Society Director, then gave a report on the Baltimore Meeting.

COLORADO SECTION—*Denver, April 8:* Following dinner, Col. F. B. Maltby reminisced on the subject of his early engineering experiences while with the Denver and Rio Grande Railroad. The speaker of the evening—Dr. R. G. Gustavson, head of the chemistry department of the University of Colorado—was then introduced and spoke on the subject, "Chemistry, War, Civilization." Dr. Gustavson divided civilization into three epochs: (1) the period of utilization of natural products, (2) the period of adaptation of natural products, and (3) the period of manufacture of substitute products from unrelated natural materials. The development of processes of manufacturing nitric acid and gasoline were mentioned as examples of the type of chemistry involved. Other illustrations were synthetic rubbers, fibers, and plastics, many of which have more desirable characteristics than the natural substances that they imitate. "It is possible to reproduce certain foods," Dr. Gustavson went on to point out, "but the actual synthesis of many appears to be an impossibility. Many of the vitamins have been isolated and several can be synthesized, but the best source still appears to be the natural food products."

Georgia Section—*Atlanta, April 14:* The speaker at this regular luncheon meeting was C. J. Bowen, Atlanta building inspector. Mr. Bowen traced the history of the Atlanta Building Code and pointed out the tremendous amount of work his office is required to handle. He also stated that lack of personnel prevented his department from functioning as efficiently as it should. At the conclusion of his talk considerable discussion from the floor evidenced the interest of the membership in the building code. Before adjourning the group authorized the president to appoint a committee to cooperate with a similar committee from the American Institute of Architects in investigating the adequacy of the present building code.

Indiana Section—*Indianapolis, April 9:* Interesting facts concerning defense training in the state of Indiana were brought out by Prof. C. W. Beese, of Purdue University, who has charge of the training of workers in certain industries for the state. His principal interest is in the engineering schools of the state—Purdue University, Rose Polytechnic Institute, and Notre Dame. In the training, defense is defined liberally and anyone who is a potential defense worker is eligible for training. Workers are selected by either the Indiana State Employment Service or one of the three engineering schools. Professor Beese went into detail regarding the mechanics of securing grants for training and for financing the training program. These programs include classes in engineering design, time study, electronics, production engineering or supervision, and other training of like nature. Other programs being followed in different parts of the country are devoted to adapting civil and mechanical engineers to manual engineering, to training ordinary engineers for the design of aeroplanes, the manufacture and use of explosives, and so on.

Lehigh Valley Section—*April 14 and 21:* At the first of these meetings, which was held at Lafayette College in Easton, Pa., the senior-class students at Lafayette and Lehigh University were dinner guests of the Section. The feature of the occasion was an illustrated lecture on the construction of the Potomac River Bridge between Ludlow Ferry, Md., and Dahlgren, Va. This was given by William H. Pahl, project engineer for the J. E. Greiner Company, of Baltimore. There was a turn-out of almost a thousand for the meeting on the 21st, which was a joint session with the Engineers Club of the Lehigh Valley held at Bethlehem. The special attraction was an illustrated lecture on "Flying in Peace and War," given by Igor Sikorsky.

Los Angeles Section—*April 9:* Soil mechanics and foundation problems were the subjects of discussion, the speakers being Frederick J. Converse, assistant professor of civil engineering at the California Institute of Technology, and William W. Moore, of Dames and Moore, foundation and soil mechanics engineers of Los Angeles. Professor Converse spoke on "The Basic Principles of Soil Mechanics in Engineering," while Mr. Moore discussed the foundation problems involved in the construction of aircraft factories and other defense projects. By means of slides Mr. Moore illustrated the application of the principles of soil mechanics to the selection and design of foundations for plants and other structures now being erected in connection with the defense program.

Metropolitan Section—*April 16:* A symposium on "Engineering Training for Defense" was the feature of the occasion. The scheduled speakers were Thorndike Saville, dean of the college of engineering at New York University, who discussed "Emergency Training Programs and Their Relation to Normal Technical Programs"; Harry S. Rogers, president of the Polytechnic Institute of Brooklyn, whose subject was "The Defense Training Institute of Greater New York"; and Walter E. Jessup, Field Secretary of the Society, who spoke on the need for civil engineers in national defense. The paper outlined in detail the many training courses now being conducted in elementary, advanced, and specialized branches of engineering; the status of engineer employment in connection with defense activities; and the outlook for technical men upon the completion of the defense program. The possible effects of emergency training and defense activities upon engineering education were discussed by Prof. James K. Finch, of Columbia University, and Secretary Seabury.

Mid-Missouri Section—*Jefferson City, March 10:* Preliminary to a dinner meeting there was a session devoted to discussion of engineering education. To start the program Robert B. Brooks, Director of the Society, discussed the salary situation, stating that Arizona and Nevada have adopted salary classifications, and that Indiana, Iowa, and Missouri are working on one. Engineers must think of social welfare, which includes adequate salaries as well as professional activities, Mr. Brooks pointed out. Other phases of the subject were discussed by William R. Chedsey, dean of the Missouri School of Mines; Harry Rubey, chairman of the civil engineering department at the University of Missouri; and Ernest E. Howard, Director of the Society. Following a brief discussion from the floor, the Section joined the Cole County Engineers' Alumni Association (including both the University of Missouri and the Missouri School of Mines) for dinner. Later the group was entertained by the Jefferson City Telephone Company, which presented an educational program entitled "Fifty Years of the Telephone."

Nashville Section—*April 1:* Following the routine business of the Section, a technical program was presented by Maj. O. E. Walsh, of the Corps of Engineers, U.S. Army. Major Walsh was assisted by civilian personnel of the War Department, including F. B. Campbell and G. O. Prados, engineers; F. H. Wolf and F. P. Gaines, associate engineers; and T. W. Jordan, Jr., senior engineering aide. The program as presented consisted of a review of the design of the proposed Wolf Creek Dam on the Cumberland River, Kentucky. Major Walsh discussed the more general features of design, while the civilian personnel covered the methods used and went into a more detailed discussion of the design.

Oregon Section—*Portland, April 23:* Various aspects of defense projects were discussed at this meeting. First, Col. Richard Park, division engineer for the North Pacific Division of the U.S. Engineer Office, spoke on the "Design and Construction of National Defense Projects in the Pacific Northwest." Colonel Park, who discussed the more general aspects of these projects, was followed by Ben L. Peterson, senior engineer for the North Pacific Division, who went more closely into engineering details of the projects. Moving pictures showing the details of cantonment construction were then presented by Maj. Paul D. Berrigan, executive assistant for the Portland Engineer District.

Philadelphia Section—*April 8:* A large number of members and guests assembled to hear a discussion of Philadelphia's water problem. The main speaker was Nathan B. Jacobs, president of Morris Knowles, Inc., consulting engineers of Pittsburgh, Pa. Mr. Jacobs, who is at present employed by the city of Philadelphia in connection with the rehabilitation of its water supply, gave a brief review of the water problem of the city from the time of Benjamin Franklin to the present. He pointed out that there has always been a difference of opinion as to the advisability of utilizing nearby sources or of developing a more remote and purer supply. This has resulted in a lack of a definite program of development and a lack in the maintenance and improvement of the present system. At the present time, Mr. Jacobs stated, it has been decided to reject the idea of an upland source of supply and to proceed with the improvement of existing facilities. He then described the present system, the Belmont, Upper and Lower Roxborough, and Queen Lane plants on the Schuylkill, and the Torresdale plant on the Delaware. His talk was discussed by Seth M. Van Loan, chief of the Bureau of Water, who described the organization set up for carrying out the proposed improvements. Other discussers were James H. Allen, engineer for Incodel, and Charles A. Howland, staff engineer for the Bureau of Municipal Research.

St. Louis Section—*April 28:* Robert G. Dyktor, of Washington University, and William G. Purdy, of the University of Missouri, winners of the Section's 1941 student awards, were present as guests of the Section and were introduced to the members. Capt. Albert Fregosi, executive officer for the Quartermaster Corps, then gave a description of the construction of Fort Leonard Wood. The last-minute change in location of the fort from Iowa to a site south of Rolla, Mo.; the lack of adequate roads, railroad connections, and housing facilities for the army of workmen required; the deep mud encountered; and the necessity for speed were cited as some of the special problems in the construction of this huge training center. During the discussion which followed Captain Fregosi's address, F. G. Jonah described some of the difficulties encountered in locating and building the railroad connection from the main line of the St. Louis–San Francisco Railway (of which Colonel Jonah is chief engineer) to the camp project.

San Francisco Section—*April 15:* Papers on various phases of engineering education were presented by Baldwin M. Woods, professor of mechanical engineering at the University of California; Hubert H. Hall, chief engineer for the Standard Oil Company of California; and Henry D. Dewell, president of the California

State Board of Registration for Civil Engineers. In the general discussion that followed, the value of proficiency in oral and written expression was emphasized. It was also recommended that all engineering students should be required to have some minimum period of engineering office experience as a prerequisite for graduation.

Spokane Section—*April 17:* The civil engineering students in the graduating classes at the University of Idaho and Washington State College were guests of the Section at a banquet. Students from Montana State College had also been invited, but found it impossible to attend. A symposium on engineering education had been scheduled for the occasion, and the first speaker was A. D. Butler, city engineer of Spokane, who discussed the relationship between the engineering graduate and his employer. Jesse E. Buchanan, dean of the college of engineering at the University of Idaho, then commented on some of the social aspects of engineering education. The third speaker on the program was M. K. Snyder, a member of the State Board of Engineering Examiners, who outlined the qualifications for professional engineers and their relation to engineering graduates. The student's point of view on engineering education was ably presented by James Dalton, of the University of Idaho, and Ralph Smith, of Washington State College.

Tri-City Section—*Moline, Ill., April 18:* A paper on airports comprised the technical program. This was presented by George W. Brunkhorst, of the firm of Consoer, Townsend and Quinlan, Chicago consulting engineers. The paper dealt with such points as proper selection of site with a view toward future expansion. It was pointed out that hundreds of airports have been abandoned during the past few years solely because of shortsightedness in selection of site.

Virginia Section—*Norfolk, May 2 and 3:* The two-day spring meeting of the Section was held in conjunction with the Engineers' Club of Hampton Roads and local groups of the other Founder Societies. After a business session on the first day the meeting was addressed by Dr. W. B. Kouwenhoven on "Electric Shock," and by F. R. Murphy on "Modern Architecture." At luncheon the group was welcomed to Norfolk by City Manager C. B. Borland, following which movies of Mariners' Museum were shown. A technical session in the afternoon, under the direction of the Virginia Section, was addressed by Brig. Gen. James A. Anderson on the subject of "Engineers and the National Defense." The other speakers on the program were E. M. Hastings, chief engineer of the Richmond, Fredericksburg and Potomac Railroad, whose subject was "Transportation and the National Defense," and Prof. J. Ormondroyd, who discussed "Vibration Problems." The dinner meeting was addressed on the subject of national defense by the Hon. Colgate W. Darden. A talk on "Helicopters" was also given by W. R. Le Page. The following day was devoted to an inspection trip around Hampton Roads by boat.

Student Chapter Notes

College of the City of New York—*April 3 and 24:* At the first of these meetings J. O. May, engineer in charge of estimating and designing for the American Bridge Company, spoke on highway bridges in their relationship to traffic. By means of slides he illustrated the various types of bridges from the most primitive forms to such present-day structures as the Bronx-Whitestone Bridge. On the 24th Nathan Cherniack, statistical analyst for the Port of New York Authority, discussed the subject, "Traffic Surveys and Analysis." In his talk, Mr. Cherniack covered the general way in which traffic and other data relating to the construction of transportation structures were compiled, treated, and interpreted.

New York University—*April 2 and 30:* The role that metropolitan engineering schools play in national defense was discussed at the first of these sessions by Thorndike Saville, dean of the college of engineering at New York University. Possible openings for the prospective graduates were itemized. Pictures of the Tacoma Bridge failure were shown at the second meeting. The structure was then discussed by A. G. Hayden, contact member for the Chapter, and by a member of the engineering staff of the Consolidated Edison Company, who was present as a guest.

Newark College of Engineering—*April 7:* Frederick Glenz, of the Port of New York Authority, gave an illustrated lecture on the construction of the Queens-Midtown Tunnel.

University of Illinois: The University of Illinois Chapter reports that the month of April was an interesting and busy one for the membership. Speakers at the weekly meetings included H. W. Richardson, Western editor of *Engineering News-Record*, who gave an illustrated lecture on "Tunnels and Tunneling"; and C. M. Hathaway, engineer of construction for the Illinois Department of Public Works and Buildings, whose talk was entitled "The Young Engineer on Construction." On April 4 and 5 the Chapter took part in the biennial Illinois Student Engineering Exhibit. Many aspects of civil engineering were stressed, and the various laboratories were in full operation. The main attraction was a colored motion picture of the collapse of the Tacoma Bridge.

Washington State College: A recent letter from the Washington State College Student Chapter reports an active and interesting year and submits the accompanying photograph of the members of the Chapter.

Members of the Washington State College Student Chapter

ITEMS OF INTEREST

About Engineers and Engineering

CIVIL ENGINEERING for July

FOREMOST among those papers planned for the July number are two that had to be omitted from the June issue at the last moment for lack of space. One by Russell G. Hornberger covers an interesting pumping plant for irrigation use on the Flathead Indian Reservation in Montana, as announced more fully in the May number. Another treats of a new and unique type of passenger railroad car. This was written by George E. Solnar. It describes the experimentation in developing this innovation and particularly the success of a new principle of suspending the car body.

Performance tests of engineering structures are particularly enlightening when they can be compared with similar runs on models. Such were the performance tests run on the Madden Dam in Panama, as described by P. S. O'Shaughnessy. These additional hydraulic data were collected at operating heads which approximate the original test heads on the models.

Among other papers in the July issue will be two in continuation of topics already begun. Treatment of the question of roads in the theater of military action will be continued by consideration of bridging operations, to be treated by Maj. Robert H. Burrage. A further article by Ralph Lowry describes concreting operatings on Shasta Dam, including the long haul of the aggregates on a mammoth belt conveyor to the dam site and the processing and placing of the concrete in the dam prism. A variety of other subjects will complete the July CIVIL ENGINEERING.

Winsor Memorial

THE PROJECT for a suitable memorial to the late Frank E. Winsor, former Vice-President of the Society, has been under way for some time and is now approaching fruition. The stone and bronze memorial has been given a commanding site on Winsor Dam, main structure for the Quabbin Reservoir on the Swift River northeast of Springfield, Mass.

Unveiling of this memorial is set for 11 a.m., on Tuesday, June 17. Many of Mr. Winsor's great circle of friends will be present to do him final honor. One of the principal addresses is to be made by Secretary Seabury. All members of the Society are invited to this dedication.

National Applied Mechanics Meeting

MANY members of the Society are interested in applied mechanics, as demonstrated by the activity of the committee on that subject in the Structural Division. This committee is cooperating with the Heat Transfer Division of the American Society of Mechanical Engineers at the eighth national meeting of the Applied Mechanics Division of the A.S.M.E. The University of Pennsylvania will be host and the time will be June 20 and 21.

Separate technical sessions will cover the topics of: (1) heat transfer, fluid mechanics and thermodynamics; (2) elasticity and plasticity; and (3) vibrations. A fourth session will be on elasticity and plasticity and in this the Society's Committee is taking an active part by sponsoring four papers by members of the Society.

On behalf of the Society, the Committee on Applied Mechanics is acting through its chairman, E. L. Eriksen, and its secretary, R. D. Mindlin. Members wishing to receive printed programs of the meeting should communicate with Society Headquarters.

Prof. N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

THE JUNE meeting of the Engineers Club was to feature an address by Professor Scrubal on "Prefabricated Earth Dams," so we were surprised to see a dozen architects introduced as guests. But there was a reason after all; perhaps the Scotch Bungalow of Mac McMack, with its saving of 19 cents worth of blueprints per unit, could be adapted to slum-clearance projects in the U.S.

Their attention centered on Professor Neare as he stepped up to the blackboard and drew the simple figure, labeled "Front View = Top View."

"You will recall, gentlemen, the McMack Bungalow," began the Professor. "Will someone volunteer to draw the required side view?"

Four members stepped up to the board and, when they turned around, the board looked like this: [See at right.]

"Well, there's perfect agreement between Sam and Don. Are they right, J. W.?"

"Perfect, Noah," said Mr. Pickworth. "It's the only solution, so far as I know. Earl must have known Mack, too; he's caricatured the old Scot admiring one of his bungalows after the landscaping was completed. But, Earl, why wasn't the building in the background built in the same style?"

"So the postman could tell them apart."

"And Oscar has drawn two sketches like the others except for extra wrinkles. Steps, maybe."

"That's right, Professor. An American improvement to avoid the McMack patents. Top and front views are still alike."

"Thanks, Oscar. I hope you have your patent, because the architects have been copying everything on the board."

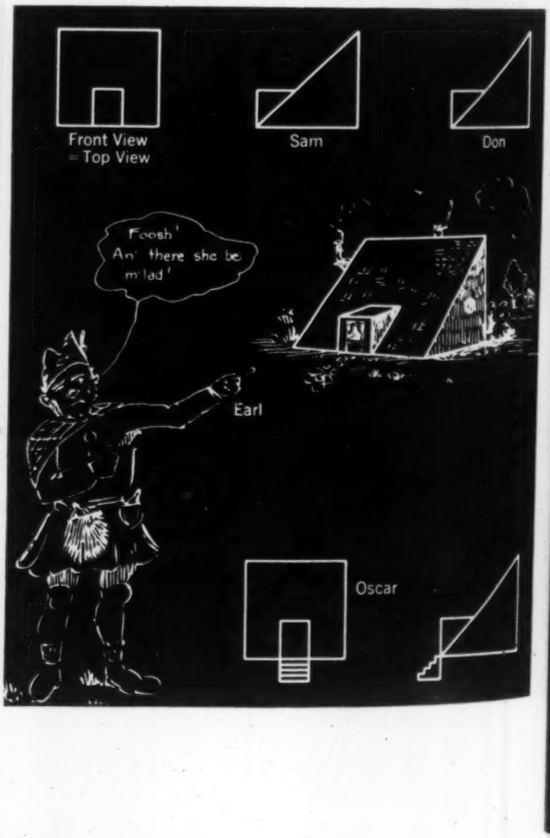
"They wouldn't have to copy if their memories were as good. as mine," exclaimed Clyde. "I saw that problem in print 20 years ago. Worth reviving, tho, and the steps give it a new approach."

"I guess no problem is really new, but Al E. Dayde says he has one. As it is over the heads of the architects, they can go home. I yield the floor to Mr. Dayde."

"This may sound easy, Professor, but I had some trouble figuring the area of a symmetrical tract I surveyed for the Government. Each of the four sides was 80 chains long, two opposite sides were true north-south lines and the other two were true east-west lines. Does that sound too easy?"

"Deceptively so, Al. Gentlemen, you have until August."

(Sam, Don, and Oscar were early birds who dated their replies April 2, being respectively and more respectfully: Samuel F. Newkirk, Jr., Donald A. Booth, and O. W. Kochtitzky, Jr. Earl and Clyde are Earl K. Burdick and Professor Clyde T. Morris, the latter referring us to page 311 of French's *Engineering Drawing*. There were many other later answers, all correct.)



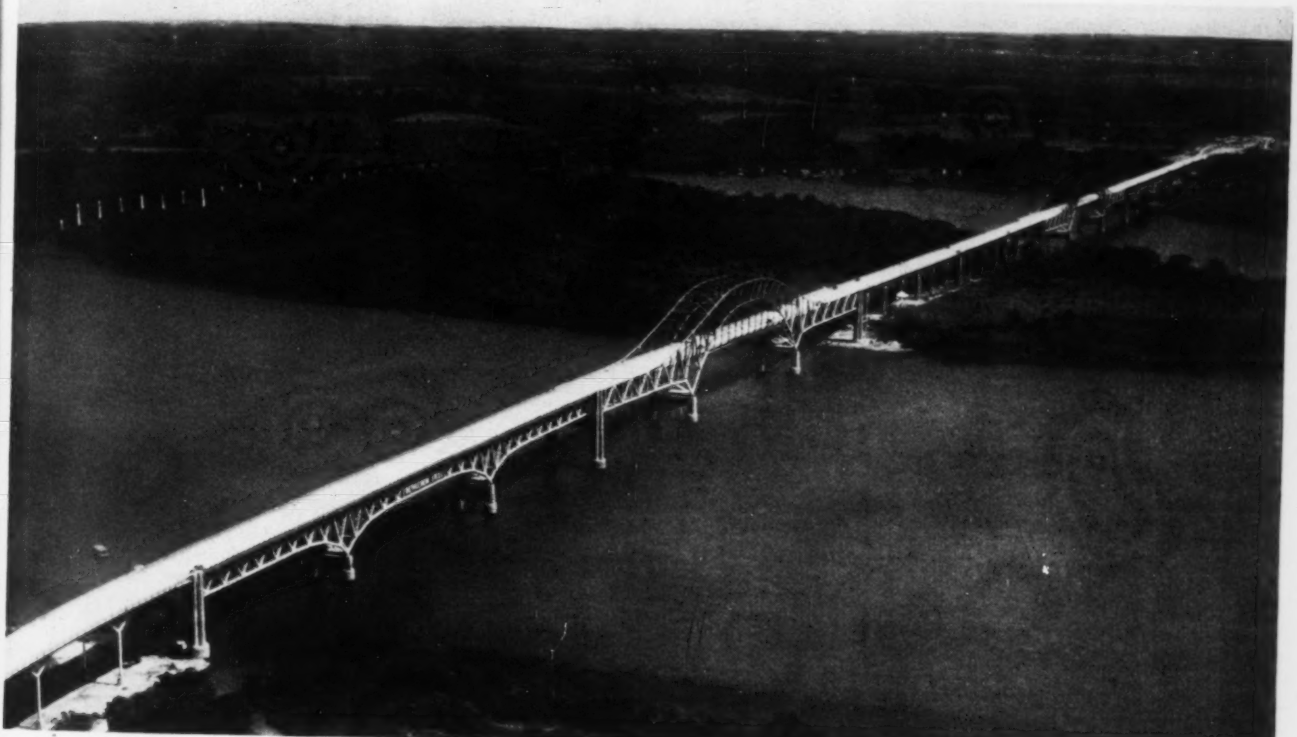
Steel Bridge Awards Announced

Selection of the prize winners for the most beautiful steel bridges completed and opened to traffic during the calendar year 1940 has been announced. These awards are sponsored by the American Institute of Steel Construction, through which the present notice is given. The following are the classifications and prize winners:

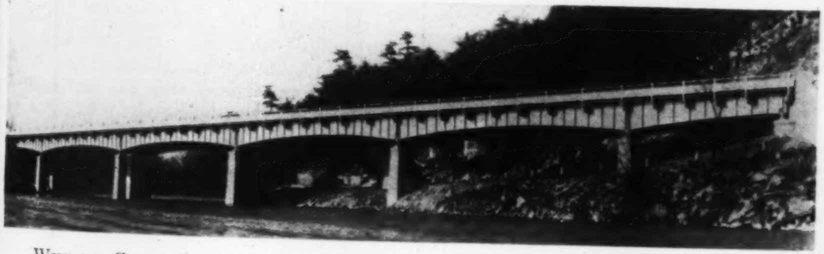
Class A, bridges costing $1,000,000 or more. Winner, Susquehanna River Bridge, between Havre de Grace and Perryville, Md.; engineers, J. E. Greiner Company. Honorable Mention: Ohio River Bridge, Owensboro, Ky.; engineers, Modjeski and Masters. Pennsylvania Avenue Bridge, over Anacostia River, District of Columbia; engineers, Parsons, Klapp, Brinckerhoff, and Douglas.

Class B, bridges costing $1,000,000–$250,000. Winner, Dunnings Creek Bridge, Pennsylvania Turnpike in Bedford Township, Pa.; engineers, Parsons Klapp, Brinckerhoff, and Douglas. Honorable Mention: Lakefront Road Viaduct, Cleveland, Ohio, designed and built under the supervision of John O. McWilliams, County Engineer of Cuyahoga County.

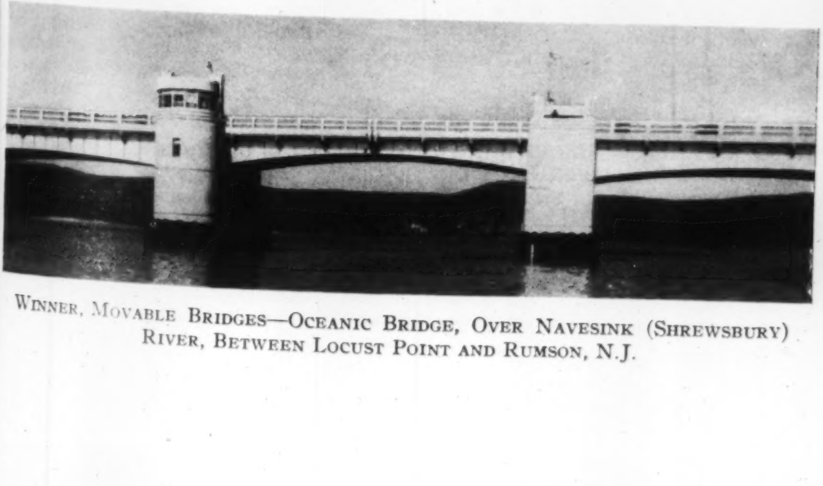
Class C, bridges costing less than $250,000. Winner, Klamath River Bridge, Orleans, Humboldt County, Calif.; engi-



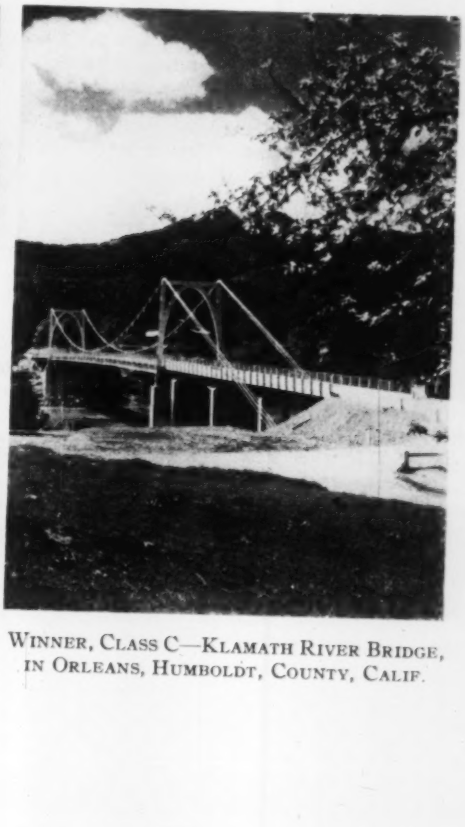
Winner, Class A—Susquehanna River Bridge, Between Havre de Grace and Perryville, Md.



Winner, Class B—Dunnings Creek Bridge, Pennsylvania Turnpike; in Bedford Township, Pa.



Winner, Movable Bridges—Oceanic Bridge, Over Navesink (Shrewsbury) River, Between Locust Point and Rumson, N.J.



Winner, Class C—Klamath River Bridge, in Orleans, Humboldt, County, Calif.

neers, C. H. Purcell, State Highway Engineer; F. W. Panhorst, Bridge Engineer, Department of Public Works, State of California. Honorable Mention: Fort Littleton Interchange Bridge, carries Interchange Ramps over Pennsylvania Turnpike at Fort Littleton Interchange, Pa.; engineers, Pennsylvania Turnpike Commission. Flatbush Avenue Bridge, Belt Parkway, Brooklyn, N.Y.; engineers, Madigan-Hyland.

Movable Bridges. Winner, Oceanic Bridge, over Navesink River (North Branch of Shrewsbury River) between Locust Point and Rumson, N.J.; engineers, Howard, Needles, Tammen and Bergendoff. Honorable Mention: Cambridge Creek Bridge, over Cambridge Creek, Cambridge, Md.; engineers, Henry G. Perring Company. Erie Avenue Bascule Bridge, over Black Run, Lorain, Ohio; engineers, J. W. Watson and Associates.

These awards were officially transmitted at a dinner given by the American Institute of Steel Construction at the Engineers' Club in New York on May 21. The winners were selected by a jury consisting of Prof. Francis P. Witmer of the University of Pennsylvania; Prof. Edward J. Squire of Brooklyn Polytechnic Institute; John A. Thompson, Architect; W. Stanwood Phillips, Architect; and Waldo G. Bowman, Editor of *Engineering News-Record.* Professors Witmer and Squire and Mr. Bowman are members of the Society.

Brief Notes

A SPECIAL summer course is announced by the University of Tennessee, Knoxville, covering multiple-purpose basin planning. Activities of the TVA will demonstrate the engineering principles. In addition, economics and sociology will have their place. Information regarding the course, which is scheduled to extend from June 9 to July 16, may be obtained from the Dean of Engineering at the University of Tennessee, Knoxville.

* * * *

A CONFERENCE on hydrology will be held at the Pennsylvania State College, State College, Pa., from June 30 to July 2, under the joint sponsorship of the section of hydrology of the American Geophysical Union, the civil engineering division of the Society for the Promotion of Engineering Education, the Committee on Hydrology of the American Society of Civil Engineers, and Pennsylvania State College. Inquiries may be addressed to Prof. F. T. Mavis, State College, Pa.

* * * *

THE COLLEGE of engineering of the University of Iowa announces that, under the National Defense Training Program for engineers, it will offer an intensive four-week summer course in the mechanics of fluids from June 9 to July 3. While the course is offered primarily for instructors and engineering students of advanced standing, the sole prerequisites are undergraduate mathematics, physics, and applied mechanics. The cost of the course will be borne by the government under the National Defense Training Program, but each registrant will be responsible for his room, board, and incidental expenses. Since enrolment in the course will be limited, advance registration is required. Applications will be accepted in order of their receipt and should be addressed to Dean F. M. Dawson, College of Engineering, University of Iowa, Iowa City, Iowa.

* * * *

TO ANSWER the demand for a comprehensive but short program in soil mechanics, the department of civil engineering at the Massachusetts Institute of Technology is again offering summer courses—June 16 to July 25. These courses, which cover the same scope as a full year of graduate study, are open to graduate students and may be taken for credit toward the degree of master of science. Applications for registration should be addressed to the Registrar, Massachusetts Institute of Technology, Cambridge, Mass., and all other inquiries regarding the course to Prof. Donald W. Taylor, Room 1-330, at the Institute.

NEWS OF ENGINEERS

Personal Items About Society Members

STILL more members of the Society in the Officers Reserve Corps of the Army and in the U.S. Naval Reserve have been ordered to active duty. Included in the former group are Col. Jesse Fred Brown, from assistant engineer for Black and Veatch, of Kansas City, Mo., to the 110th Engineers at Camp Robinson, Ark.; Lt. Col. William N. Carey, from consulting engineer of St. Paul, Minn., to the Jacksonville (Fla.) District, where he will assist in the construction of eight army airports and air bases; Lt. Col. R. C. Sweeney, from district sanitary engineer for the Albany District of the New York State Department of Health, to the headquarters of the 5th Corps Area, Ft. Hayes, Ohio; Maj. Frank M. Keller, from San Francisco, Calif., to the Quartermaster Corps at Fort McDowell, Calif.; Capt. Cyril S. Adams, from Frederic R. Harris, Inc., of New York City, to the ordnance section of the Second Division at Fort Sam Houston, San Antonio, Tex.; Capt. Walter Vincent Barry, from director of public works and city engineer of New Haven, Conn., to the 301st Engineers, 76th Division, at Fort Henry G. Wright, Fishers Island, N.Y.; Capt. Alvin McGee Mock, from structural engineer for the Austin Company of Cleveland, Ohio, to the Corps of Engineers, U.S. Army, at Arlington, Va.; Capt. James K. Searcy, from assistant engineer for the U.S. Geological Survey at Jackson, Miss., to duty with the Coast Artillery Corps at Wilmington, N.C.; and Lt. Garner W. Reed, from shaft engineer for the New York City Board of Water Supply to the Naval Air Station at Quonset Point, R.I.

JAMES K. FINCH, Renwick Professor of Civil Engineering at Columbia University, has been appointed associate dean of the faculty of engineering. Professor Finch has been a member of the Columbia staff for thirty-one years and has headed the civil engineering department since 1932.

ARTHUR C. NAUMAN, captain, Corps of Engineers, U.S. Army, was recently transferred from the 6th Corps Area of the War Department, Chicago, Ill., to Fort George Wright, Spokane, Wash.

HERBERT S. CROCKER announces that **ALFRED J. RYAN** will be associated with him in the practice of civil engineering under the firm name of Crocker and Ryan. The firm, located at 901 First National Bank Building, Denver, Colo., will specialize in structures, hydraulics, and municipal utilities. Colonel Crocker has maintained a consulting practice in Denver for some years, while Mr. Ryan was previously assistant structural engineer for the Tennessee Valley Authority.

P. B. STREANDER has been engaged by Stone and Webster to handle water supply and sanitation work on their defense contracts and munitions manufacturing.

S. S. GORMAN is now chief assistant to the district engineer of the Shipbuilding Division of the Bethlehem Steel Company. His headquarters are in San Francisco, Calif.

A. L. LANE has been promoted from the rank of major in the Corps of Engineers, U.S. Army, to that of lieutenant colonel. He is stationed at the Engineer Replacement Center, Fort Belvoir, Va.

MALCOLM H. JONES has been transferred from the U.S. Engineer Office at Rock Island, Ill., where he was assistant hydraulic engineer, to the office of the Chief of Engineers, U.S. Army, Washington, D.C.

HARLAND BARTHOLOMEW, G. DONALD KENNEDY, and **C. H. PURCELL** are members of a committee recently appointed by President Roosevelt to recommend a limited system of national highways "designed to provide a basis for improved interregional transportation."

HUNG H. LING, director and engineer-in-chief of the Chengtu-Tienshui Railway, Chengtu, Szechuan, China, has been elected president of the Chinese Institute of Engineers for the current year.

W. S. MORTIMER has severed his connection with the Washington State Highway Department, Spokane, Wash., in order to accept a position as draftsman with the Boeing Aircraft Company at Seattle, Wash.

H. G. SUEHRSTEDT, formerly connected with the Stark Construction Company, of Cedar Rapids, Iowa, has taken up new duties as chief resident engineer on the Plum Brook Ordnance Plant at Sandusky, Ohio, for the E. B. Badger and Sons Company, of Boston.

GLENN H. ALLEN recently resigned as district engineer for the Indiana State Highway Commission at Vincennes, Ind., in order to form an engineering and contracting partnership with J. L. Wilson. The firm, which is to be known as Allen and Wilson, will have general headquarters at Vincennes.

James H. Stratton has been promoted from the rank of captain, Corps of Engineers, U.S. Army, to that of major. He is district engineer in the U.S. Engineer Office at Caddoa, Colo.

Mortimer E. Cooley, Honorary Member of the Society and dean emeritus of the colleges of engineering and architecture at the University of Michigan, was one of twelve alumni of the University recently honored by citations praising their professional achievements. Other members of the Society thus honored were **James H. Herron**, consulting engineer of Cleveland, Ohio; **Clifford E. Paine**, consulting engineer of Chicago, Ill.; **Murray D. Van Wagoner**, governor of Michigan; and **Henry F. Vaughan**, of the University of Michigan staff.

F. R. Schanck, of Portland, Ore., has accepted a position as civil engineer for the Navy Department on the work of constructing bases on the sites leased from the British government. His present assignment is at the Naval Air Station on the island of Antigua, B.W.I.

Henry F. Vaughan, for the past twenty-three years commissioner of health of the city of Detroit, Mich., has resigned to become professor of public health at the University of Michigan.

George W. Schusler, of Pittsburgh, Pa., has accepted the position of construction superintendent for the Westinghouse Electric and Manufacturing Company.

Gerald F. McKinney was recently promoted to the position of assistant division engineer in the Ohio State Highway Department at Chillicothe. He was formerly division bridge engineer.

Albertis Montgomery, lieutenant colonel, Corps of Engineers, U.S. Army, is now stationed at Sylacauga, Ala., as chief engineer and assistant to the constructing quartermaster in charge of an ordnance plant for the army. Until lately Colonel Montgomery was constructing quartermaster at Camp Davis, Holly Ridge, N.C.

Harry Tucker, professor of highway engineering at North Carolina State College, has been appointed a member of the North Carolina State Utilities Commission.

Seth B. Morris, previously a detailer for the American Bridge Company at Trenton, N.J., recently accepted a position as associate engineer with Parsons, Klapp, Brinckerhoff and Douglas, New York City consulting engineers.

B. D. Keatts has resigned as field engineer for the Portland Cement Association, with headquarters in Milwaukee, Wis., in order to become an engineer for the Dur-Ite Corporation, a concrete construction engineering firm of Chicago, Ill.

Lewis B. Smith was recently appointed to the post of city superintendent of water for Rochester, N.Y. For the past four years Mr. Smith has been in charge of park improvements of the county highway department.

Ulysses S. Grant, 3d, brigadier general, Corps of Engineers, U.S. Army, has been relieved of duty as division engineer for the Great Lakes Division, Cleveland, Ohio, and assigned to command the engineer replacement training center at Fort Leonard Wood, Mo.

Rossiter M. McCrone, formerly senior engineer in the Gulf of Mexico Division of the U.S. Engineer Department at New Orleans, La., is now senior engineer in the Office of the President of the Mississippi River Commission at Vicksburg, Miss.

H. C. Turner, founder and president of the Turner Construction Company, of New York City, has been elected to the newly created position of chairman of the Board of Directors of the company, and in this capacity will continue to be actively identified with its affairs.

DECEASED

Adam Carl Beyer (Assoc. M. '31) district manager for the Wallace and Tiernan Sales Corporation of San Francisco, Calif., died on April 30, 1941, at the age of 39. Mr. Beyer was assistant city engineer of San Rafael, Calif., from 1925 to 1927, and sales engineer for the Pelton Water Wheel Company from 1927 to 1929. From the latter year on he was with Wallace and Tiernan.

Hartley Robert Church (Assoc. M. '11) associate highway engineer for the California State Division of Highways, San Luis Obispo, Calif., died in San Francisco on April 21, 1941. He was 64. Mr. Church's earlier activities included railroad and municipal work in the Middle West and California. He became connected with the State Highway Department in 1922 and was transferred from Sacramento to San Luis Obispo in 1926.

Walter Rudolph Eberhardt (Assoc. M. '26) manager of the New York District of the H. K. Ferguson Company, died on April 4, 1941, at the age of 48. Mr. Eberhardt had been in the employ of several Cleveland (Ohio) companies, including the Cleveland Electric Illuminating Company. He became connected with the H. K. Ferguson Company in 1926.

Robert Farnham (M. '10) assistant chief engineer of the Eastern region of the Pennsylvania Railroad, died at his home at Chestnut Hill, Pa., on April 8, 1941. Mr. Farnham, who was 63, had been with the Pennsylvania Railroad for thirty-eight years. He was in charge of construction work on the Union Station in Washington, and in 1927 was put in charge of the Philadelphia improvement program, embracing construction of the Broad Street suburban station and the Thirtieth Street Station. Before assuming his connection with the Pennsylvania Railroad, he was employed in the engineering department of the District of Columbia. Long a member of the Society, Mr. Farnham served as Director from 1924–1926.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

Ray Stuart Gatens (Assoc. M. '17) with the Public Roads Administration at Fort Worth, Tex., died in that city on April 10, 1941. He was 53. Mr. Gatens was city manager of Winter Haven, Fla., for five years before going to Fort Worth in 1933. At one time, also, he maintained a consulting practice in Winter Haven.

Arthur Woodroffe Manton (M. '13) of London, England, died in that city recently. Mr. Manton, who was 74, was noted as an engineer in this country and Canada as well as in England. He was in charge of constructing the Great Western Railway Sodbury Tunnel, and was deputy managing engineer for the Pennsylvania Railroad on the construction of the East River tunnels in New York. For some years he served as tunnel engineer for Sir Lindsay Parkinson and Company, Ltd.

Morris Fremder Marks (M. '30) consulting engineer of St. Louis, Mo., died in that city on March 29, 1941, at the age of 47. Before establishing his practice Mr. Marks was for many years chief engineer for W. J. Knight and Company, of St. Louis, and earlier in his career had been with the Concrete Steel Fireproofing Company of the same city.

Charles Beach Nolte (M. '32) since 1935 president of the Crane Company, of Chicago, Ill., died in that city on April 29, 1941. Mr. Nolte, who was 55, was president of the Robert W. Hunt Company, Chicago engineering firm, for six years before he was elected to head the Crane Company. He went to the Hunt Company as engineer in 1909 at the outset of his engineering career.

Eliot Barber Parsons (M. '27) consulting engineer of Watertown, Wis., died there recently. He was about 70. Mr. Parsons was city engineer of Fond du Lac, Wis., from 1893 to 1904, and of Watertown, Wis., from 1904 to 1908. In the latter year he established his practice at Watertown, serving as consulting engineer for numerous Wisconsin municipalities.

Royal Ellsworth Petty (Assoc. M. '24) structural engineer for the Wheeling and Lake Erie Railway, Cleveland, Ohio, died in that city recently at the age of 49. Earlier in his career Mr. Petty was for some years designer for the Cleveland Union Terminals Company.

Charles Russ Richards (M. '23) retired president of Lehigh University, died in Minneapolis, Minn., on April 17, 1941, at the age of 70. Dr. Richards was on the faculty of the University of Nebraska from 1892 until 1911—for the last years of this period as dean of the engineering college. He was dean of engineering at the University of Illinois from 1913 to 1922, and president of Lehigh University from the latter year until 1935 when ill health forced his retirement.

Lucius Johnson Schnell (Assoc. M. '35) assistant superintendent for the Virginia Engineering Company, died in Tampa, Fla., on April 1, 1941. Mr. Schnell, who was 42, had spent some years in the employ of Stone and Webster, Inc., of Boston, Mass. He had also been with the H. K. Ferguson Company, of Cleveland, Ohio, for whom he built silk and rayon mills in the South, and he had remodeled the plant of the Libby Glass Company at Toledo, Ohio.

Stuart Hobbs Sims (M. '15) of Las Cruces, N.Mex., died on April 3, 1941, at the age of 59. From 1903 to 1914 Mr. Hobbs was engaged in railroad, water supply, building design, and valuation work, and from 1914 to 1927 he was on the engineering faculties of several universities. From 1927 to 1935 he was life underwriter and manager of the Sun Life Assurance Company of Canada.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From April 10 to May 9, 1941, Inclusive

Additions to Membership

Bacon, George Donald (Jun. '41), 1st Lt., Cavalry, U.S. Army, 67th Armored Regiment, Fort Benning, Ga.

Blomgren, Eric Edwin (M. '41), Dist. Engr., State Highway Dept., 407 County Bldg. (Res., 3112 Kenilworth Ave., R. F. D. 1), Kalamazoo, Mich.

Bostandjis, Harilaos Michael (M. '40), Granite House, Cannon St., London, E.C. 4, England.

Calvin, Elmer Lyle (Jun. '40), 2d Lt., Corps of Engrs., U.S. Army, 10th Engr. Battalion (Res., Fort Lewis Inn), Fort Lewis, Wash.

Carniglia, Joseph William (Jun. '40), Asst. Engr., U.S. Bureau of Reclamation, 701 K St., Sacramento, Calif.

Davis, Oray Madison, Jr. (Jun. '41), 739 North Albermarle St., Arlington, Va.

DeJarnette, William Pou, Jr. (M. '41), Capt., Corps of Engrs., U.S. Army, U.S. Custom House, Mobile, Ala.

Dietz, Jesse Clay, Jr. (Jun. '41), Hydraulics Laboratory, Univ. of Wisconsin, Madison, Wis.

Eaton, Richard Orville (Assoc. M. '40), Engr. (Civ.), U.S. Engr. Office, War Dept., 751 South Figueroa St., Los Angeles, Calif.

Fajman, William Joseph (Jun. '41), Asst. Insp., Ordnance Material, New York Ordnance Dist., War Dept., 80 Broadway, New York (Res., 28-35 Thirty-fifth St., Long Island City), N.Y.

Fettis, William George, Jr. (Jun. '41), Contract Engr., Great Am. Indemnity Co., 1 Liberty St., New York, N.Y.

Fuller, Theodore Albert (Assoc. M. '41), Capt., Corps of Engrs., U.S. Army, Engineer School, Fort Belvoir, Va.

Geralde, John James (Jun. '41), Junior Naval Archt. (P-1), U.S. Navy, Navy Yard, Philadelphia, Pa. (Res., 34 Parkway West, Mount Vernon, N.Y.)

Gorton, Marquand Sarchet (Jun. '41), 2100 Virginia St., Apt. 11, Berkeley, Calif.

Green, William Wells (Jun. '41), Office Engr., City Engrs. Office, City Hall (Res., 504 Morgan St.), Corpus Christi, Tex.

Hall, Francis Everett (M. '41), City Engr. and Supt., Water and Sewer Dept., City Hall (Res., 1800 Washington Ave.), Greenville, Miss.

Hands, Glenn Elbert (Assoc. M. '41), With Burns & McDonnell Eng. Co., 107 West Linwood (Res., 5225 Euclid Ave.), Kansas City, Mo.

Hansen, Melville Birger (Jun. '41), Asst. Engr., B. C. Pulp & Paper Co., Ltd., Woodfibre, B.C., Canada.

Hardenbergh, Donald Edward (Jun. '41), Senior Hydrographer, Federal State Flood Forecasting Service, State Dept. of Forest and Waters (Res., 1111 Penn St.), Harrisburg, Pa.

Hill, Kenneth Vinton (M. '41) (Greeley & Hansen), 6 North Michigan Ave., Room 1700, Chicago, Ill.

Hofmann, Walter (Jun. '41), Junior Hydr. Engr., U.S. Geological Survey, 1100 Washington Bldg., Tacoma, Wash.

Isaak, Elmer Bramwell (Assoc. M. '41), Traffic Engr., Madigan-Hyland, 20 Exchange Pl., New York (Res., 1269 California Rd., Tuckahoe), N.Y.

Kranick, Martin Everett (Jun. '40), Junior Engr., U.S. Bureau of Reclamation, New Customhouse (Res., 1025 Lincoln St.), Denver, Colo.

Kunsch, Harold Edward (Assoc. M. '41), Squad Leader, Whitman, Requardt & Smith, Edgewood Arsenal Office, Edgewood (Res., 5102 Harford Rd., Baltimore), Md.

Lesher, Carl Eugene, Jr. (Jun. '41), San. Engr. Draftsman, H. K. Ferguson Co., Milan, Tenn.

Libner, Harry Richard (Jun. '41), Asst. Engr., U.S. Engr. Office, Clock Tower (Res., 2415 Nineteenth Ave.), Rock Island, Ill.

Long, John Frederick (Jun. '41), Care, U.S. Engr. Office, M and M Bldg., Houston, Tex.

Lynch, Robert Cornelius (Jun. '40), Draftsman, Lehigh Structural Steel Co., Front and Allen Sts. (Res., 124 North 15th St.), Allentown, Pa.

McCandles, Charles Sprague (Jun. '41), Constr. Engr., Ford J. Twaits (Res., 309 South Hobart), Los Angeles, Calif.

McKenzie, Andrew Jackson, Jr. (Jun. '41), Pres., M. & M. Constr. Co., 1100 West Commerce, Dallas, Tex.

McLaughlin, William Coleman (Assoc. M. '41), Senior Insp., Constr., Bureau of Yards and Docks, Public Works Dept., U.S. Navy, Mare Island (Res., 904 Maine St., Vallejo), Calif.

Madden, Edward Bingham (Jun. '41), Junior Engr., U.S. Engr. Office, 3d and Broadway, Little Rock, Ark.

Nelson, Glenn Russell (Jun. '40), Junior Engr., U.S. Army Engrs., Young Hotel (Res., 3365 Kaimuki), Honolulu, Hawaii.

Nelson, William Howard (Assoc. M. '41), Senior Civ. Engr., Eng. Dept., City of Seattle, County City Bldg. (Res., 4210 Bagley Ave.), Seattle, Wash.

O'Neil, William Edward, Jr. (Assoc. M. '40), Associate San. Engr., National Park Service, 710 Grace Securities Bldg. (Res., 1214 Laburnum Ave.), Richmond, Va.

Palmer, Fred Robert (Assoc. M. '41), Constr. Engr., Sammons Const. Co., 414 Eleventh St., Huntington, W.Va.

Permar, David Robert (Jun. '40), Junior Civ. Engr., U.S. Coast Guard, 1700 Keith Bldg., Cleveland, Ohio.

Peterie, Lester Leroy (Jun. '40), Kinsley, Kans.

Ross, Henry Albert (Jun. '41), Senior Eng. Aid. State Highway Dept., 1200 North Center St., Stockton (Res., 941 Sonoma Way, Sacramento), Calif.

Sanders, Gordon Stephen (Jun. '40), Material Lister, Austin Co., Naval Air Station (Res., 4718 Eighteenth, N.E.), Seattle, Wash.

Scisson, Sidney Eugene (Jun. '41), Junior Engr., U.S. Engr. Office, Wright Bldg. (Res., 1719 East 14th St.), Tulsa, Okla.

Spencer, Arthur Clifton (Assoc. M. '41), Supt., Building and Constr. Dept., Consolidated Gas, Elec., Light and Power Co., Monument St., Baltimore, Md.

Spofford, James (M. '41), Associate Engr., U.S. Bureau of Reclamation, Custom House (Res., 554 South Emerson St.), Denver, Colo.

Steenhill, Niels Kold (Jun. '40), Care, Rust Eng. Co., Clark Bldg., Pittsburgh, Pa.

Stewart, Charles G. (M. '41), Asst. Chf. Engr., P. & L. E. R.R., P. and L. E. Terminal Bldg., Pittsburgh, Pa.

Tewinkel, Garrett Carper (Jun. '40), Prin. Eng. Draftsman, SCS, 1023 West Riverside (Res., 1102 West Sharp), Spokane, Wash.

Turner, John Kendrick (Assoc. M. '41), Asst. Hydr. Engr., TVA, 515 Union Bldg., Knoxville, Tenn.

Wall, Harry Boykin (Assoc. M. '41), Field Materials Engr., State Highway Comm. (Res., 16 Beverly Pl.), Little Rock, Ark.

Warshaw, Seymour (Jun. '41), 2145 East 21st St., Brooklyn, N.Y.

Wenzel, Leland Keith (Assoc. M. '41), Hydr. Engr., U.S. Geological Survey, 18th and F Sts., N.W., Washington, D.C.

TOTAL MEMBERSHIP AS OF MAY 9, 1941

Members	5,699
Associate Members	6,610
Corporate Members	12,309
Honorary Members	34
Juniors	4,586
Affiliates	70
Fellows	1
Total	17,000

Membership Transfers

Blickensderfer, Alfred (Jun. '33; Assoc. M. '41), Asst. Hydr. Engr., TVA, 701 Union Bldg. (Res., 3708 McCalla Ave.), Knoxville, Tenn.

Cox, Glen Nelson (Jun. '28; Assoc. M. '35; M. '41), Prof., Mechanics and Hydraulics, Eng. Bldg., Louisiana State Univ., University, La.

Greenleaf, John Whittier, Jr. (Jun. '36; Assoc. M. '41), Asst. Engr., Metcalf & Eddy, 1300 Statler Bldg., Boston (Res., 232 Pond St., Westwood), Mass.

Housel, William Stuart (Jun. '24; Assoc. M. '28; M. '41), Research Consultant, State Highway Dept.; Associate Prof., Civ. Eng., Univ. of Michigan, Room 1224 East Eng. Bldg., Ann Arbor, Mich.

Hutchison, Alfred Dresel (Assoc. M. '33; M '41), Senior Res. Engr., State Highway Dept., Courthouse, Greenville, Tex.

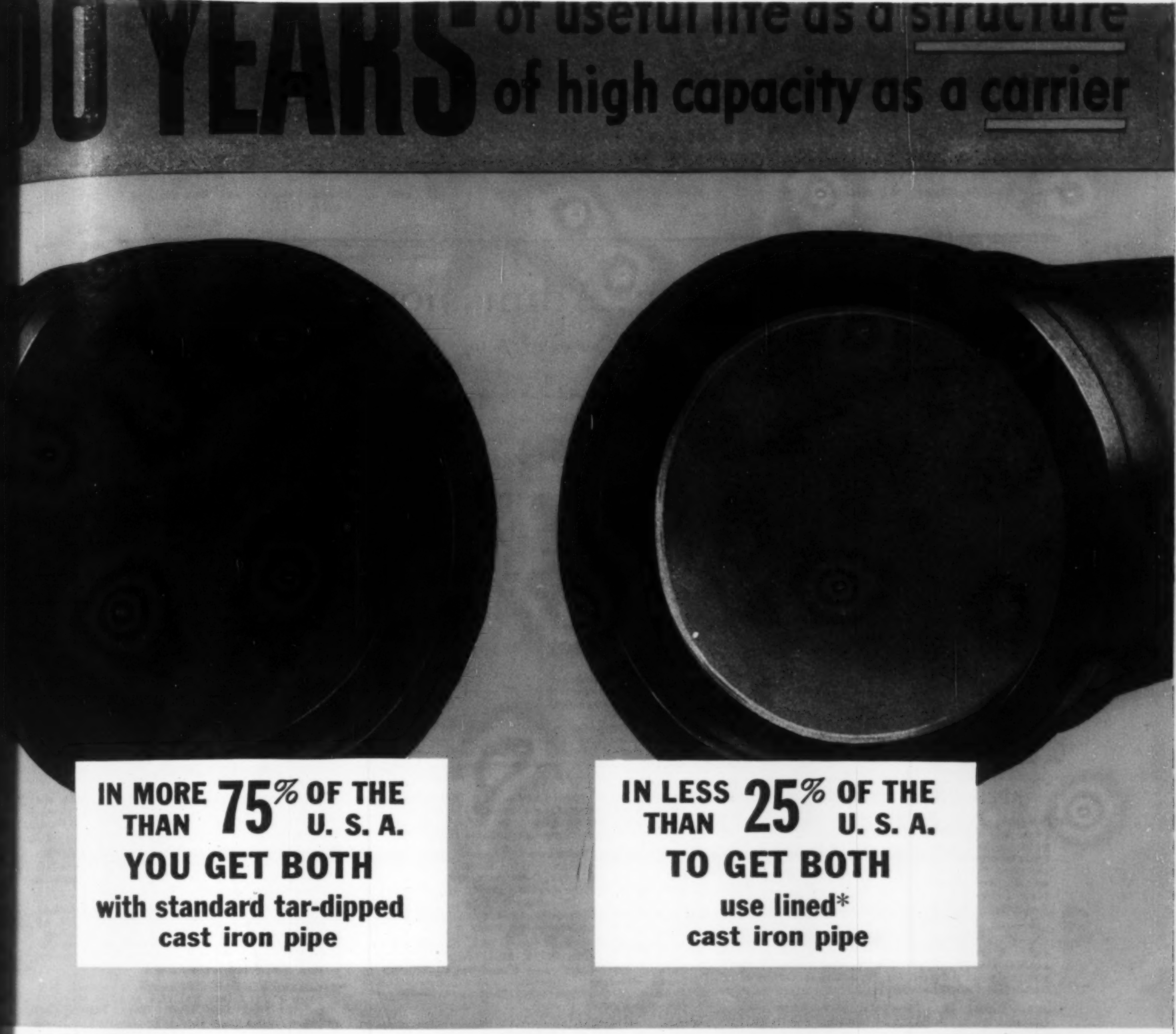
Jones, Joseph William (Assoc. M. '27; M. '41), Res. Engr., B. & O. R.R., Mt. Royal Station, Baltimore, Md.

Lambrecht, Richard Waldo (Assoc. M. '32; M. '41), Vice-Pres., O. W. Burke Co., 1010 Fisher Bldg., Detroit, Mich.

Samuel, Myer (Jun. '30; Assoc. M. '41), Engr. (Civ.), U.S. Engr. Office, Post Office Bldg., Sacramento, Calif.

Setterlin, Ralph Frederick (Jun. '29; Assoc. M. '41), Building Contr. (R. W. Setterlin & Son), 1030 West 3d Ave. (Res., 1244 Forsythe Ave.), Columbus, Ohio.

Tschudy, Lionel Carl (Assoc. M. '28; M. '41), Asst. Regional Engr., In chg. Constr., SCS, U.S. Dept. of Agriculture, Old Post Office Bldg., Amarillo, Tex.



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YOUNGS, LYMAN GUSTIN (Jun. '31; Assoc. M. '41), Asst. Highway Engr., Dist. 4, Public Roads Administration, 1109 Main Post Office Bldg., St. Paul, Minn.

REINSTATEMENTS

FOX, CHARLES KIRBY, M., reinstated April 22, 1941.

GARD, WALTER SUMNER, Jun., reinstated April 10, 1941.

HINRICHS, ADOLF, M., reinstated April 14, 1941.

LOSEE, MILTON GILBERT, Assoc. M., reinstated April 25, 1941.

ROBSON, FREDERICK THURSTON, Assoc. M., reinstated April 30, 1941.

WRIGHT, EARL SEAWARD, Assoc. M., reinstated April 30, 1941.

RESIGNATIONS

FOWLER, CHARLES EVAN, M., resigned April 23, 1941.

MAGNUSSON, CARL EDWARD, M., resigned April 14, 1941.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

June 1, 1941 NUMBER 6

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

BARNARD, CHARLES CLIFTON, Arlington, Va. (Age 35) (Claims RCA 3.0 RCM 8.3) Sept. 1940 to date Prin. Engr. of Constr., Office of Quartermaster Gen., Washington, D.C.; previously Chf. Engr. on Union Passenger Terminal project employed jointly by City of New Orleans and 9 railroads; Project Engr., Resettlement Div., Dept. of Agriculture.

COOK, HOWARD LEE (Assoc. M.), Bethesda, Md. (Age 35) (Claims RCA 1.1 RCM 7.5) April 1935 to date with U.S. Dept. of Agriculture as Soil Conservationist, SCS, and (since July 1940) Tech. Adviser on Hydrology, Office of Land Use Coordination.

DUBA, JOHN, JR., Newport, R.I. (Age 48) (Claims RCA 1.0 RCM 21.5) Oct. 1919 to date with Public Works Office, U.S. Navy, as Civ. Eng. Aide, Associate Civ. Engr., and (since July 1940) Senior Civ. Engr., Naval Air Station, Quonset Point, R.I.

FURRER, EMERY CLOYD, Chicago, Ill. (Age 46) (Claims RCA 9.2 RCM 8.8) April 1941 to date Chf. Draftsman, United Engrs. & Constrs. Inc.; previously Structural Designer with City of Chicago, Chicago Park Dist., and Leonard Constr. Co.

GARTNER, WILBUR HAROLD, South Bend, Ind. (Age 42) (Claims RCA 6.0 RCM 14.4) 1921 to 1941 Engr., with Chas. W. Cole or Chas. W. Cole & Son, Cons. Engrs., and at present Chf. Field and Constr. Engr., Giffels and Vallet, Inc., and Charles W. Cole & Son, Archts. and Engrs. for Kingsbury Ordnance Plant.

GOODING, WILLIAM JAMES, JR., Columbia, S.C. (Age 40) (Claims RCA 5.8 RCM 10.1) Oct. 1921 to date with South Carolina State Highway Dept., as Clerk, Bridge Draftsman, Bridge Designer, Prin. Designing Engr., and (since Sept. 1935) Bridge Engr.

GURLEY, LEON RAYMOND (Assoc. M.), New York City. (Age 47) (Claims RCA 3.6 RCM 20.4) May 1937 to date Senior Engr., Coverdale & Colpitts, Cons. Engrs.; previously with RA, Dept. of Agriculture, as Asst. Regional Engr., and Regional Engr.; Acting Project Engr., Oak Mountain Recreational Project, National Park Service, Birmingham, Ala.

HARNISH, CHARLES FAIRCHILD, Naples, N.Y. (Age 40) (Claims RCA 2.3 RCM 13.9) Oct. 1940 to date Asst. to Res. Director, construction, Pine Camp Cantonment Project; previously Res. Engr., Office Engr., and Designer, Wm. S. Lozier, Inc., Rochester, N.Y.

KADOW, ROBERT JOHN (Assoc. M.), North Hollywood, Calif. (Age 41) (Claims RCA 6.2 RCM 10.6) Oct. 1935 to date Prin. Structural Engr. for S. B. Barnes, Cons. Structural Engr.

KNAPP, LLOYD DUNAWAY (Assoc. M.), Milwaukee, Wis. (Age 46) (Claims RCA 16.0 RCM 7.7) Sept. 1925 to date with City of Milwaukee as Inspector, Asst. Civ. Engr., Senior Engr., Chf. Senior Engr., Engr. in Charge, Grade Crossing Abolition, and (since March 1941) Special Asst. Engr.

KNOX, JEAN HOWARD (Assoc. M.), Norfolk, Va. (Age 58) (Claims RCA 32.4) Sept. 1940 to date Constr. Engr. and Concrete Technician, Naval Defense Housing and Construction Projects, Naval Operating Base; previously on consulting work.

KUAN, FU CHUAN (Assoc. M.), Shanghai, China. (Age 37) (Claims RCA 2.5 RCM 6.2) Aug. 1938 to date Research Fellow, Sino-British Boxer Indemnity Foundation; previously Prof. and Head, Hydr. Eng. Dept., Coll. of Eng., National Central Univ., Nanking and Chunking; Chf. Engr. of Waterways, Bureau of Reconstruction, Provincial Govt. of Kiangsu.

LOBDELL, ARTHUR TREADWAY, Lincoln, Nebr. (Age 46) (Claims RCA 10.5 RCM 14.4) 1927 to date Chf., Bureau of Roads and Bridges, under State Engr., in charge of Bureau; at present Major, Engr. Reserve Corps, U.S. Army.

LOWE, THOMAS MARVEL (Assoc. M.), Auburn, Ala. (Age 44) (Claims RCA 3.0 RCM 7.6) April 1939 to date Head Prof. of Civ. Eng., Alabama Polytechnic Inst.; previously with Dept. of Civ. Eng., Univ. of Florida, as Instructor, Asst. Prof., and Associate Prof.

MAHAFFEY, STERRY JENCKS, Richmond, Va. (Age 36) (Claims RCA 3.5 RCM 11.9) Feb. 1941 to date County Mgr. Henrico County, Va.; Oct. 1937 to Feb. 1941 Town Mgr., Franklin, Va.; previously Bridge Inspector and Res. Engr., Virginia Dept. of Highways.

MARCONDES FERRAZ, OCTAVIO, São Paulo, Brazil. (Age 44) (Claims RCA 2.0 RCM 20.0) Aug. 1928 to date Director and Proprietor, Escriptorio Technico O.M.F.

MATHEWS, CLAUDE KELSEY (Assoc. M.), Kansas City, Mo. (Age 44) (Claims RCA 1.7 RCM 16.9) June 1924 to date Cons. Engr. with Burns & McDonnell Eng. Co.

MOSS, JOHN PARKER, Rogersville, Tenn. (Age 38) (Claims RCA 6.6 RCM 8.3) Oct. 1939 to date Pres. and Gen. Mgr., Moss-Thornton Co., Inc., Gen. Contrs., Birmingham, Ala.; at present in partnership with Forcum & James and Clark, Kearney & Stark; previously Contr., acting as Gen. Mgr., Clark, Kearney and Stark Gen. Contrs., St. Louis, Mo.

NABOW, DAVID, Charlotte, N.C. (Age 46) (Claims RCA 5.0 RCM 15.8) July 1925 to date Designing Engr., Duke Power Co. (successor to So. Power Co.).

REARDON, LESLIE JOSEPH (Assoc. M.), Jackson Heights, N.Y. (Age 45) (Claims RCA 4.8 RCM 11.9) Feb. 1938 to date Chf. Engr., Structural Clay Products Inst.; previously Chf. Engr., Brick Mfrs. Association of America; Res. Engr. Inspector, PWA.

SALZMAN, MILTON GREMMELS, Lynbrook, N.Y. (Age 37) (Claims RC 11.1 D 10.0) May 1936 to July 1937 Asst. Hydr. Engr., Phoenix Eng. Corporation, and July 1937 to date Civ. Engr., Ebasco Services Inc., (subsidiaries of Elec. Bond and Share Co.), both of New York City.

SERRA, JULIUS HERSCHEL, Staten Island, N.Y. (Age 55) (Claims RCA 3.8 RCM 15.9) Feb. 1930 to date Res. Engr., George H. Flinn Corporation, New York City.

SQUIRE, ANDREW BRADFORD (PIERSON), Rochester, N.Y. (Age 38) (Claims RCA 6.0 RCM 9.3) Jan. 1926 to date member of firm, Wm. S. Lozier, Inc., Civ. and San. Engrs.

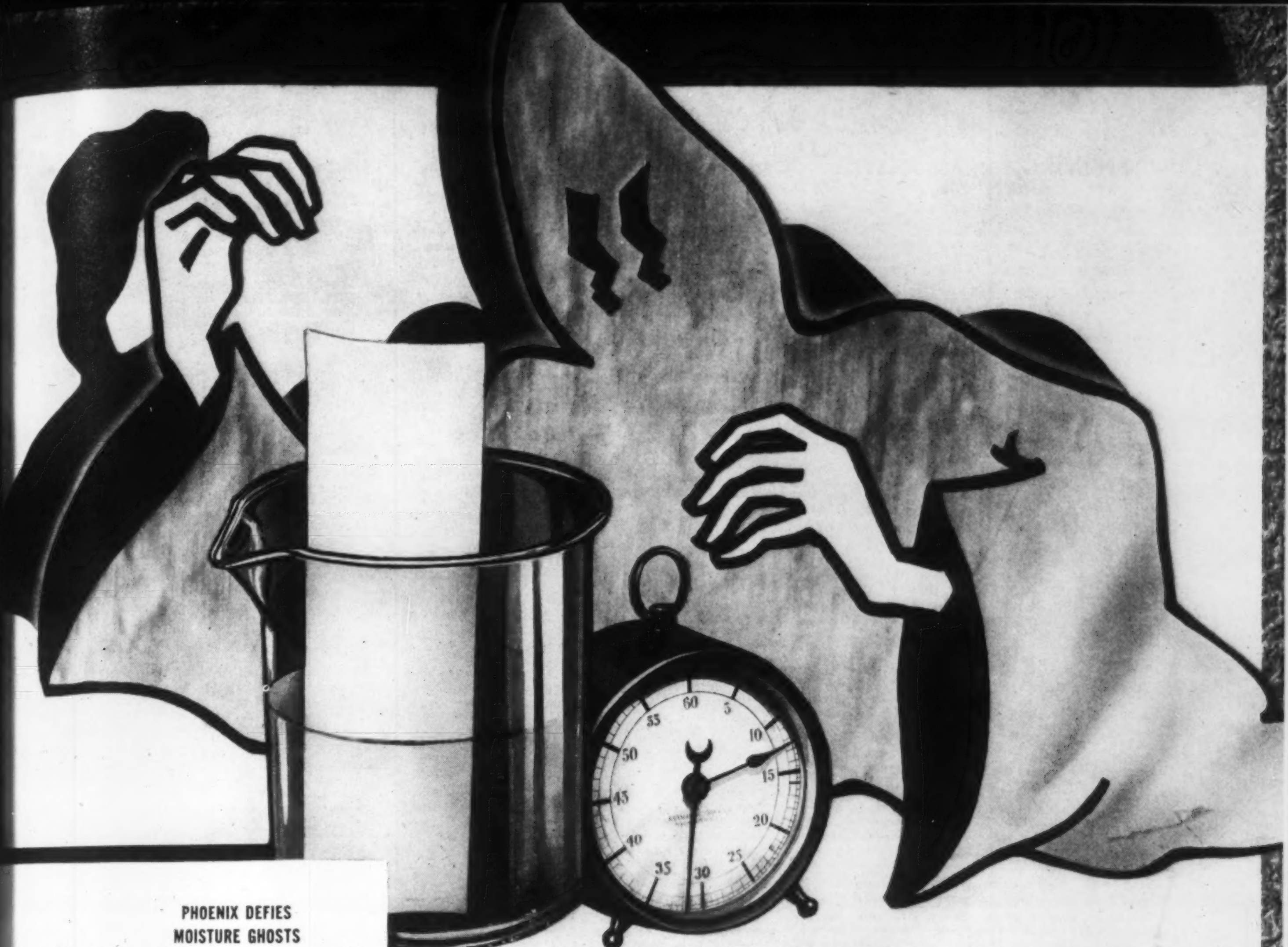
STEM, CLIFFORD HOEY (Assoc. M.), New Orleans, La. (Age 47) (Claims RC 23.6) Aug. 1924 to date Pres. and Chf. Engr., New Orleans (La.) Equipment Co.; Major, Corps of Engrs., U.S. Army Reserves, assigned to Engr. Board, U.S.A.

STEPHENSON, LOWELL JOSEPH (Assoc. M.), Quantico, Va. (Age 41) (Claims RCA 4.6 RCM 12.5) March 1941 to date Lieut., Civ. Eng. Corps, U.S. Naval Reserves; Jan. 1940 to March 1941, Chf. Constr. Engr., American Dredging Co., Oakland, Calif.; previously Asst. Res. Engr., Acting Res. Engr., and Executive Asst. to Res. Engr., California Div. of Highways, Dist. IV.

VAUGHAN, NORMAN ERNEST (Assoc. M.), Melbourne, Australia. (Age 38) (Claims RCA 8.0 RCM 12.2) May 1935 to date Engr. Mgr. in charge of Asphalt Dept., Vacuum Oil Co. Pty. Ltd., Melbourne.

WHALEN, WILLIAM EDWARD, Toledo, Ohio. (Age 51) (Claims RCA 12.7 RCM 12.5) Nov. 1929 to date Constr. Engr., The Electric Auto-Lite Co.

WILLIAR, HARRY DUGAN, JR., Baltimore, Md. (Age 55) (Claims RCA 14.0 RCM 13.0) 1935 to 1940 Deputy State Administrator, and 1940 to date State Administrator, WPA of Maryland



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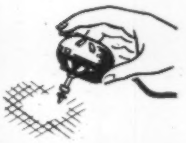

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APPLYING FOR ASSOCIATE MEMBER

Axthelm, Frederick August, Little Rock, Ark. (Age 37) (Claims RCA 4.6 RCM 2.3) Feb. 1941 to date Archt.-Engr., Benham Eng. Co.; previously with U.S. Engrs., as Inspector and Structural Designer.

Blaschke, Edwin Henry (Junior), Quincy, Mass. (Age 27) (Claims RCA 2.6) Dec. 1940 to date Asst. Res. Engr., The Foundation Co. Fore River Shipyard; previously with Lower Colorado River Authority of Texas, Austin, Tex., as Asst. Field Cost. Engr., Asst. Res. Engr., Res. Engr., Asst. Res. Inspector, and Res. Inspector.

Blitz, Joseph Phillip, New York City. (Age 33) (Claims RCA 11.2) May 1935 to date Owner, Bakert Constr. Co.; previously with Tishman Realty & Constr. Co., Inc.

Blount, George Cochran (Junior), Williams, Ariz. (Age 32) (Claims RCA 4.4) March 1934 to date with Arizona Highway Dept., as Chainman, Levelman, Recorder, Draftsman, Transitman, Locating Engr., Res. Engr. and (since Aug. 1940) Project Engr.

Blum, Albert Elias (Junior), Brooklyn, N.Y. (Age 32) (Claims RCA 3.4) June 1933 to Jan. 1937 Asst. Engr., Hygrade Constr. Co., and Jan. 1937 to date with Hygrade Kitchen Cabinet Co., Inc., at present as Vice.-Pres.

Brouk, Otto, Honolulu, T.H. (Age 34) (Claims RCA 5.9 RCM 4.3) Aug. 1940 to date Chf. Structural Engr. in charge of all structural engineering for contractors, Pacific Naval Air Bases, Honolulu, T.H.; previously Associate Structural Engr., FWA, Washington, D.C.; Asst. Structural Engr., Nimmons, Carr & Wright, Archts., Chicago, Ill.; Structural Engr., Montgomery Ward & Co., Chicago, Ill.

Brown, Robert Manassas, Midland City, Ala. (Age 41) (Claims RCA 7.1 RCM 10.0) June 1923 to date with Alabama Highway Dept., as Culvert and Pipe Inspector, Instrumentman, Draftsman, Asst. Res. Engr., and (since Jan. 1925) Res. Engr.

Brown, Walter Augustus (Junior), Colstrip, Mont. (Age 31) (Claims RCA 2.6) Jan. 1940 to date Contr.'s Engr., Foley Brothers, Inc.; previously Plant Designing Engr., Pacific Constrs., Inc., on Shasta Dam construction plant; with West Slope Constr. Co.

Butterfield, Stephen Ernest, West Hartford, Conn. (Age 29) (Claims RCA 5.4) Sept. 1935 to date (except Sept. 1938 to June 1939 on graduate study at Yale Bureau of Street Traffic Research) with Connecticut State Highway Dept., as Senior Civ. Eng. Draftsman, and since June 1939 in Div. of Highway Control as Traffic Engr. (Jun. Highway Engr.).

Carter, Vernon Lee (Junior), Topeka, Kans. (Age 29) (Claims RCA 3.0) May 1935 to date with Kansas State Highway Comm., as Rodman, Concrete Inspector, Asst. Engr. (Grade C), and since Oct. 1938 Asst. Engr. (Grade B).

Christy, Bruce Verner, Seattle, Wash. (Age 36) (Claims RCA 7.2) Feb. 1940 to date on work for U.S. Navy in Puget Sound as Project Engr. and Associate Structural Engr.; previously on bridge work in Washington and California, etc.

Corr, Francis John, Jr., Lansing Mich. (Age 35) (Claims RC 4.0 D 0.6) 1937 to date Co-Partner, Francis J. Corr & Son, building contracting, some designing.

Cox, Clifford Bugbee (Junior), Chicago, Ill. (Age 32) (Claims RCA 3.0 RCM 1.0) Oct. 1933 to date with Pacific Flush Tank Co., as San. Engr., and (since Oct. 1935) Chf. Engr.

Cromer, Orland Dwight (Junior), Socorro, N. Mex. (Age 31) (Claims RCA 4.8) April 1936 to date with U.S. Biological Survey (now Fish & Wildlife Service), as Jun. Civ. Engr., and Asst. Civ. Engr.

Crowe, George Frederick (Junior), Norfolk, Va. (Age 32) (Claims RCA 3.2 RCM 3.1) Feb. 1937 to date with U.S. Engr. Office as Structural Designer, Chf. of Design Sec., Chf., Fortification Div., and (since Sept. 1940) Chf., Design Sec.; previously Engr., Soule Steel Co., Los Angeles, Calif.

Dalton, Carl Richard, Whiteriver, Ariz. (Age 47) (Claims RCA 7.0 RCM 6.0) June 1935 to date with U.S. Dept. of Interior, Indian Field Service, as Road Engr., and (since Oct. 1938) Associate Engr.

Deane, William Francis (Junior), Washington, D.C. (Age 32) (Claims RCA 5.0) June 1930 to date Aid and Jun. Hydrographic and Geodetic Engr., U.S. Coast & Geodetic Survey.

Dement, James Washington, Jr. (Junior), Mobile Ala. (Age 32) (Claims RCA 4.2 RCM 1.4) July 1936 to date with U.S. Engr. Office as Jun. Engr., Asst. Engr., and since Aug. 1940 Capt., Corps of Engrs., U.S. Army.

Dexter, Morrell Frank, Newton, Kans. (Age 36) (Claims RCA 14.6) Aug. 1928 to date Res. Engr., Kansas State Highway Dept.

Donlon, Thomas Francis, Baton Rouge, La. (Age 30) (Claims RCA 4.2) Oct. 1935 to date Draftsman and Senior Road Draftsman, Louisiana Dept. of Highways; since March 1940 also Designer, Delta Tank Mfg. Co.

Ernest, Walter Crenshaw, Jr., Mobile, Ala. (Age 42) (Claims RCA 21.2) June 1929 to date Pres. and Chf. Engr., Ernest Constr. Co., Inc.; at present Capt., Corps of Engrs. (Reserve), U.S. Army.

Evans, Henry Pritchard, Jr. (Junior), Urbana, Ill. (Age 29) (Claims RCA 6.9 RCM 0.8) Sept. 1936 to date Associate in Civ. Eng., Univ. of Illinois; previously Asst. Engr., Jun. Engr., U.S. Bureau of Reclamation, Denver, Colo.

Evans, Jesse William, Los Angeles, Calif. (Age 36) (Claims RCA 5.5) April 1941 to date Eng. Aide (Grade III), Los Angeles County Engr. Sanitation and Storm Drain Div.; April 1939 to April 1941 with Regional Planning Comm. of Los Angeles County, as Eng. Aide (Grade III); previously with The Metropolitan Water Dist. of So. Calif., as Chainman, Draftsman, and Senior Draftsman, Design Div.

Evernham, Earle Barnett (Junior), West Allenhurst, N.J. (Age 32) (Claims RCA 5.0) April 1938 to date Constr. Engr., successively with Constr. Quartermaster, Camp Dix, N.J., Ryan Contr. Corporation, New York City, and (since July 1940) with H. K. Ferguson Co., Cleveland, Ohio; previously Estimating Engr., FSA; Draftsman, Barker Distillery, and with ERA.

Farmer, Edward August (Junior), Kansas City, Mo. (Age 33) (Claims RCA 9.7) Aug. 1933 to date Res. Engr., with Black & Veatch.

Fiscus, David Homer, National City, Calif. (Age 33) (Claims RC 6.9 D 1.7) March 1933 to date with California Water & Telephone Co., as Asst. Reservoir Keeper, Asst. Engr., and (since Aug. 1938) Div. Engr.

Gibson, Edwin Emmons (Junior), New Orleans, La. (Age 32) (Claims RCA 6.1 RCM 1.7) Oct. 1933 to Sept. 1937 and Sept. 1938 to date with U.S. Engr. Dept., as Surveyman, Chf. of Field Party, Student Engr., Jun. Engr., and (since June 1940) Asst. Civ. Engr.; at present Lieut. (jg), CEC, U.S.N.R.

Gilmont, John Alexander, Sacramento, Calif. (Age 55) (Claims RCA 20.5) Dec. 1938 to date Asst. Engr. with duties of Office Engr., Bureau of Reclamation, Sacramento, Calif.; previously Office Engr., California State Planning Board; Associate Engr. (Civil Service), I.C.C., etc.

Glendinning, Albert William, Whitmore, Calif. (Age 35) (Claims RC 8.0) June 1933 to date with U.S. Forest Service as Truck Trail Locator, Associate Constr. Engr., etc., and (since May 1939) Project Supt., Whitmore (Calif.) CCC Camp.

Gutierrez Braun, Federico, San Jose, Costa Rica. (Age 47) (Claims RCA 16.5 RCM 4.5) May 1940 to date Director of Public Roads; Jan. 1937 to May 1940 in full charge of location and construction of new water-supply for Port Limon; previously with United Fruit Co., Costa Rica Div.

Hamilton, George Washington, Knoxville, Tenn. (Age 33) (Claims RCA 3.2) Oct. 1934 to date with TVA as Eng. Aide, Jun. Hydr. Engr., Asst. San. Engr., and (since Jan. 1941) Associate San. Engr.

Hunt, Dick Alwyn, Alexandria, La. (Age 40) (Claims RCA 9.9) Oct. 1940 to date with W. Horace Williams Co., Contrs., being Chf. Estimating Engr.; previously with WPA as Constr. Supt.; with FEA of PW (PWA) as Asst. Res. Engr. Inspector; Cons. Engr., Town of Franklinton, La.; co-partnership, Hunt & Dibdin, Engrs. and Surveyors.

Hyde, Obert Robert, Kodiak, Alaska. (Age 39) (Claims RCA 12.5) Oct. 1940 to date Prin. Gen. Inspector of Constr., Naval Air Station, Kodiak, Alaska; previously with Washington Dept. of Highways as Res. Engr.

Jacobs, Roy Kenneth (Junior), Atlanta, Ga. (Age 32) (Claims RCA 2.1 RCM 0.1) Sept. 1937 to May 1941 Instructor, and May 1941 to date Asst. Prof., in engineering drawing and mechanics, Georgia School of Technology; previously Structural Engr., Hausman Steel Co., Toledo, Ohio.

Johnson, Wendell Eugene (Junior), Diablo Heights, Canal Zone. (Age 30) (Claims RCA 2.8) Oct. 1940 to April 1941 Senior Engr., and April 1941 to date Prin. Engr., The Panama Canal; previously with U.S. Engr. Office as Student Engr., Jun. Engr., Asst. Engr., Associate Engr., Engr., and Senior Engr.

Keller, Frank, Jr. (Junior), Santa Fe, N.Mex. (Age 30) (Claims RCA 1.8 RCM 0.5) Nov. 1940 to April 1941 Jun. Agri. Engr., and April 1941 to date Asst. Agri. Engr., Range Development Service, General Land Office; previously with SCS, Safford, Ariz., as Instrumentman, Jun. Eng. Aide, Asst. Eng. Aide and Jun. Agri. Engr.

Kowitz, Arthur William (Junior), White Hall, Ill. (Age 31) (Claims RCA 2.3 RCM 5.5) Nov. 1935 to date with SCS, as Camp Engr., CCC Camp, Jun. Soil Conservationist, and (since Feb. 1940) Asst. Soil Conservationist.

Levitt, Edward Tobins, New York City. (Age 33) (Claims RCA 4.4) May 1929 to May 1941 intermittently with Lustig and Weil, Inc., as Layout Engr., Constr. Supt. and Engr.; Sept. 1934 to April 1935 Draftsman for R. Scharf, New York City; previously Draftsman with George F. Hardy, Cons. Engr.

Lipinski, Edward Eugene, Sparrows Point, Md. (Age 32) (Claims RCA 3.7 RCM 1.0) April 1935 to date Engr., James Stewart & Co., Inc., Contrs.

Litton, Hailey Clifton, Arlington, Va. (Age 41) (Claims RCA 7.6) April 1941 to date Structural Engr., U.S. Navy Dept., Washington, D.C.; Sept. 1938 to April 1941 with WPA, Johnson City, Tenn., in charge of bridge construction; previously Structural and Mechanical Designer, North American Rayon Corporation; Jun. Civ. Engr., and Constr. Supt., U.S. Forest Service, Johnson City.

Long, George Stevenson, Elizabethtown, Ky. (Age 53) (Claims RCA 11.7 RCM 2.3) Dec. 1940 to date Design Engr., Havens & Emerson, Fort Knox, Ky.; previously Asst. Engr., Sewerage Div. Service Dept., Akron, Ohio.

Lutrick, Reece Richard, Dallas, Tex. (Age 41) (Claims RCA 12.8) June 1923 to date with Mosher Steel Co., as Structural Steel Draftsman, Estimator, Designer and Salesman, Chf. Engr., and (since Aug. 1932) Industrial Engr.

McClellan, Merritt Charles, Arlington, Nebr. (Age 38) (Claims RCA 4.5 RCM 0.7) July 1927 to date with U.S. Geological Survey as Jun. Topographic Engr., Asst. Topographic Engr., and (since Nov. 1940) Associate Topographic Engr.

Milliron, William Ralph (Junior), Hazlegreen, Mo. (Age 28) (Claims RCA 1.4) Jan. 1941 to date Office Engr. for Gen. Supt., R.R. Office Engr. for Contrs., on construction of Fort Leonard Wood (Mo.) 7th Corps Training Center; previously with C. F. Lytle Co., Contrs. Al Johnson Constr. Co., Frank S. Currie Co., U.S. Engr. Office, and Berkeley (Calif.) Board of Education.

Murray, Walter James, Diablo Heights, Canal Zone. (Age 34) (Claims RCA 6.4 RCM 0.8) Aug. 1940 to date Asst. Engr., The Panama Canal, Balboa Heights, Canal Zone; previously Senior Bridge Draftsman, Maryland State Roads Comm., Baltimore.

Newton, Glenn Everette, San Francisco, Calif. (Age 39) (Claims RCA 7.9) Nov. 1940 to date with Eng. Staff of Transportation Dept., California R. R. Comm.; Sept.–Oct. 1940 Asst. Valuation Engr., J. B. Lippencott Eng. Co., Los Angeles; previously in partnership on building contracting, construction, etc.; Asst. Valuation Engr., Los Angeles Ry. Corporation.

Newton, Ralph William, Evanston, Ill. (Age 49) (Claims RCA 15.9) May 1934 to date with PWA as Res. Engr. Inspector, and (since Dec. 1936) Chf. Res. Engr. Inspector.

O'Donnell, Herbert Preston (Junior), Lodi, Calif. (Age 33) (Claims RCA 1.5) Nov. 1933 to date (except March to April 1934) with California Div. of Highways, Sacramento, Calif., as Senior Engr. Aide, Rodman-Chainman, Jun. Highway Engr., Draftsman, Asst. Res. Engr., and (since March 1941) Jun. Bridge Engr., Bridge Dept., acting as Asst. Res. Engr.

Oxford, John W., Jr. (Junior), Huntsville, Ala. (Age 31) (Claims RCA 8.2 RCM 0.4) Jan. 1941 to date Chf. Engr., G. W. Jones & Sons, City Engrs., County Surveyors and general engineering practice; previously Inspector Designer, Jun. Engr. and Acting Chf. of Party and Asst. Engr., Alabama Highway Dept., Montgomery; Flood Control Engr., Project Supt., and Jun. Civ. Engr., U.S. Forest Service, Chattanooga, Tenn.

Ramseier, Roy Edwin (Junior), Berkeley, Calif. (Age 29) (Claims RCA 4.2) July 1940 to date Asst. Engr., East Bay Cities sewage-disposal survey; previously with Alameda County Mosquito Abatement Dist., as Draftsman etc.; Res. Engr., Decoto (Calif.) San. Dist.; Designing Engr. for John A. Mancini.

Redmile, Harold Franklin (Junior), Morgantown, W.Va. (Age 27) (Claims RCA 5.2) July 1935 to date with E. I. du Pont de Nemours and Co., Inc., as Pipe Fitter Helper, Rodman, Transitman, Layout Engr., Area Engr., Asst. Constr. Supt., and (since Dec. 1940) Asst. Constr. Supt.

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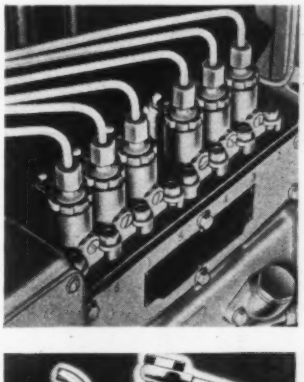

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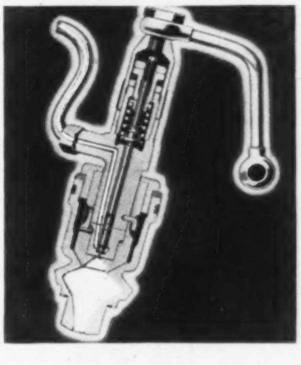

MORE MONEY SAVED HERE!

"Caterpillar" pumps supply fuel under pressure to the injection valve which automatically unseats to shoot an atomized spray of fuel into the cylinder. No mechanical operating adjustments here, either—and another "Caterpillar" precision-built assembly! The design of the injection valve assures continuous conditioning of even the heavier, lower cost fuels which are further prepared for combustion by the pre-combustion chamber. In this chamber (shown below valve) the spray of fuel is changed into a hot swirling gas. The fuel in this gaseous state passes into the cylinder where additional air is available to complete the combustion and the power stroke. The design of this system enables the use of low-cost fuels and assures efficient operation.

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REG. U.S. PAT. OFF.
ENGINES AND ELECTRIC SETS • TRACK-TYPE TRACTORS • ROAD MACHINERY

Rippstein, Edwin Eugene, University City, Mo. (Age 39) (Claims RCA 10.5) April 1928 to date with Laclede Steel Co., St. Louis, Mo., $2^1/_2$ years as Draftsman and Estimator, and remainder of time in responsible charge of Eng. Dept.

Rizzi, Charles Alfred, Scarsdale, N.Y. (Age 37) (Claims RCA 13.0) Sept. 1925 to date with R. E. Carrick Co., as Asst. to Chf. Estimator and Engr., Chf. Estimator and Engr., Secy., and since 1937 Vice-Pres. in charge of New York Office.

Stein, Philip Charles, Cambridge, Mass. (Age 36) (Claims RCA 4.4 RCM 3.4) June 1937 to June 1940 graduate student, and Sept. 1939 to date Instructor, Massachusetts Inst. Technology; in the interim Engr. with Jackson & Moreland, Boston, Mass.

Thomas, Robert Scofield (Junior), Oakland, Calif. (Age 30) (Claims RCA 3.8 RCM 1.0) Feb. 1941 to date Lieut. (jg), CEC, U.S.N.R., San Francisco, acting as Asst. to Public Works Officer, Twelfth Naval Dist.; previously with U.S. Bureau of Reclamation as Jun Engr., Asst. Engr., and Associate Engr.

Tudor, Sidney Thomas, Sacramento, Calif. (Age 34) (Claims RCA 10.8) Nov. 1933 to June 1936 Chf. of Survey Party at Rolla, Mo., and March 1941 to date Senior Eng. Field Aid, at Sacramento, Calif. for U.S. Geological Survey; in the interim Project Engr., on county-wide road and bridge construction, Jackson County, and Asst. Engr., Inter-city Sewer, No. 24 Highway and Brookside, Kansas City, Mo.

Voorhees, John Culver, Knoxville, Tenn. (Age 34) (Claims RCA 2.4) Feb. to Aug. 1936 Prin. Eng. Draftsman, and Aug. 1936 to date Asst. Structural Engr., TVA; previously Asst. Engr.,Laclede Steel Co., St. Louis, Mo.

Weiss, Frederick Ludwig, Lenoir City, Tenn. (Age 37) Oct. 1933 to date with TVA, Knoxville, Tenn., as Job Engr., Asst. Supt., and since July 1936 Field Engr., Constr. Div.

Wilson, Edgar Beryl, Oklahoma City, Okla. (Age 29) (Claims RC 2.5) July 1939 to date Structural Engr., Portland Cement Association; Sept. 1937 to July 1939 State Engr., NYA; previously Engr., Oklahoma Agricultural & Mechanical Coll.

Wilson, John Thomas (Junior), San Marino, Calif. (Age 31) (Claims RCA 8.5) March 1941 to date Structural Engr., Donald R. Warren, Structural and Civ. Engr., Los Angeles; previously Bldg. Inspector, Plan Checker and Structural Engr., Los Angeles County Dept. of Bldg. & Safety.

Woodall, Max Theodore, Haverford, Pa. (Age 31) (Claims RCA 4.3) Dec. 1940 to date with United Engrs. & Constrs. Inc., Philadelphia, Pa., checking structural designs in structural steel and reinforced concrete; previously with American Rolling Mill Co., and F. H. McGraw Co.; with Corps of Engrs., U.S. Army, Huntington, W.Va., as Asst. to Res. Engr.

APPLYING FOR AFFILIATE

McCune, Robert Francis, Denison, Tex. (Age 35) (Claims RC 11.5) Jan. 1941 to date Gen. Supt., Contrs., for Seventh Corps Area Training Center, Fort Leonard Wood, Mo.; previously Gen. Supt., C. F. Lytle Co., Denison; Field Supt. of Constr., C. F. Lytle Co. and Al Johnson Constr. Co.; Gen. Supt., Bennett & Taylor Constr. Co., Los Angeles; Constr. Engr. and Supt., Morrison-Knudsen Co., Boise, Idaho.

APPLYING FOR JUNIOR

Castella, William Floyd, Corpus Christi, Tex. (Age 30) (Claims RCA 4.8) Oct. 1939 to date Office Engr., Eng. Dept., Corpus Christi, Tex.; May to Oct. 1939 Project Engr., Texas Dist. No. 8, WPA, Waco, Tex.; previously Cartographer, State-Wide Planning Survey Div., Texas Highway Dept., Austin, Tex.; County Engr., Commr.'s Court, Phillips County, Kans.

Cotrim, John Reginald, Rio de Janeiro, Brazil. (Age 26) Jan. 1937 to date with Emprezas Electricas Brasileiras, S.A., on stream gaging and hydrographic studies, and (since Sept. 1939) Asst. Hydr. Engr.; previously with Franz Kaindl, Cons. Engr., as Draftsman and Asst. on calculations and designs.

Davis, Thomas Dale, Oswego, N.Y. (Age 24) Jan. 1941 to date 1st Lieut., Coast Artillery, U.S. Army, Fort Ontario; previously Jun. Engr., Garrow Co., Inc.; Field Asst., Coll. of the City of New York.

Deitrich, Robert Grant, Baltimore, Md. (Age 30) Jan. 1941 to date Draftsman and Designer, U.S. Engr. Office; Aug. 1932 to Dec. 1940 not on engineering; previously Instructor in mathematics and surveying, Rensselaer Polytechnic Inst., Troy, N.Y.

Dibble, Wortham Wyatt, Columbia, S.C. (Age 26) (Claims RCA 1.2 RCM 1.1) Oct. 1936 to date (except Sept. 1937 to June 1938 graduate student, Bureau for Street Traffic, Harvard Univ.) with South Carolina Highway Dept., as Laboratory Asst., Testing Div., Asst. to Traffic Engr., and (since May 1940) Acting Traffic Engr. with full administration of Traffic Eng. Div.

Fisher, Donald Moore, Salem, Ore. (Age 25) 1939 B.S., Ore. State Coll.; Aug. 1939 to date Jun. Valuation Engr., Utility Div., Oregon State Tax Comm.

Hixson, Lewis W., Lenoir City, Tenn. (Age 27) (Claims RCA 0.1) Oct. 1937 to date with TVA as Jun. Eng. Aide, Jun. Inspector of Constr., Eng. Aide, and (since Aug. 1939) Jun. Civ. Engr.; previously Layout Engr., H. J. Deutschbein Constr. Co., and Roche, Connel & Laub Constr. Co.

Johanek, John Alton, North Sacramento, Calif. (Age 29) Dec. 1937 to date with Bridge Dept., California Div. of Highways, as Structural Eng. Office Aide, and (since Jan. 1941) Jun. Bridge Engr.; previously Chainman on surveys, Bureau of Reclamation; Rodman, National Park Service.

Karp, Milton Alfred, New York City. (Age 23) Nov. 1938 to July 1940 and March 1941 to date Jun. Naval Archt., New York Navy Yard; in the interim Jun. Structural Steel Draftsman, Dept. of Docks; previously Jun. Engr., Albert A. Volk Co.

Kelley, George Larry, Little Rock, Ark. (Age 25) Sept. 1939 to Feb. 1941 Student Engr., and Feb. 1941 to date Jun. Engr., War Dept., Corps of Engrs.; previously Instrumentman, WPA, Jefferson County, Ark.

Kleinschmidt, Robert Baumgartner, Pottsville, Pa. (Age 31) Sept. 1939 to date Instructor in Civ. Eng. in Schuylkill Undergraduate Center of Pennsylvania State Coll.; previously Eng. Instructor, Monmouth Junior Coll., Long Branch, N.J.

Long, Jack Yervant, Sacramento, Calif. (Age 27) Oct. 1937 to June 1938 Laboratory Aide, and Feb. 1941 to date Jun. Structural Eng. Draftsman, California Div. of Highways; in the interim Jun. Engr., Palm Iron & Bridge Works; previously Jun. Engr., Fair Mfg. Co., San Francisco, Calif.

McKellar, Hugh Archibald, Provo, Utah. (Age 25) Aug. 1938 to date with U.S. Bureau of Reclamation as Rodman, Instrumentman, and (since Sept. 1939) Jun. Engr.

Pfeil, Arthur Elton, East Cleveland, Ohio. (Age 24) Jan. 1941 to date Structural Designer, Arthur G. McKee Co., Cleveland, Ohio; previously Chf. of Survey Party, F. A. Pease Eng. Co.; Bridge Engr., Asst. Engr. and Chf. of Field Party, Portage County (Ohio) Highway Dept.

Potter, Clarke James, Waterloo, Iowa. (Age 25) 1941 B.S., Iowa State Coll.; June to Sept. 1940 and March 1941 to date Rodman, Maintenance of Way Dept., Illinois Central R.R.; June–Dec. 1939 Asst. County Engr., Wayne County, Iowa.

Thompson, Joe Earl, Wilson, Kans. (Age 26) (Claims RC 0.2) Sept. 1940 to date with The Natural Gas Pipeline Co. of America, as Instrumentman, and (since April 1941) Chf. of Party; previously Chainman, Atchison Topeka & Santa Fe Ry. Co.

1941 GRADUATES
IOWA STATE COLL.
(B.S. in C.E.)

Age

Lieb, John Junior (22)

UNIV. OF KANS.
(B.S.)

Schroeter, Leonard Ivo (23)

N.Y. UNIV.
(B.C.E.)

Capodieci, Bernard Ernest (26)

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Personnel Service, Inc., with offices in Chicago, Detroit, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 141 of the 1941 Year Book of the Society. To expedite publication, notices should be sent direct to the Personnel Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago, Detroit, or San Francisco follows the key number, when it should be sent to the office designated.

CONSTRUCTION

Civil Engineer; Jun. Am. Soc. C.E.; 30; married; B.S.C.E., 1936; B.S.E.E., 1932; licensed; 5 years on varied concrete and steel construction, related office work with U.S. Bureau of Reclamation; 2 years supervising inspection of concrete structures. Desires position in structural design and/or construction, where all phases of job would be considered. C-842.

Construction Engineer; M. Am. Soc. C.E., 1924; heavy construction; concrete, masonry, and earth-fill dams; river and harbor improvements; hydraulic dredging; wide experience and acquaintance in Latin America; just completed ten-million-dollar construction project for federal government. C-844.

Graduate Civil Engineer; Assoc. M. Am. Soc. C.E.; 24 years executive experience on heavy construction work as the representative of a contractor; is desirous of making a contact with a contracting organization which is interested in such work as excavations, foundations, tunnels, subways, dry docks, and substructure work of large caliber. Location immaterial. C-845.

Construction and Industrial Engineer; M. Am. Soc. C.E.; B.S., 1911, and C.E., 1918, University of Maine; 20 years experience, much with heavy construction; thoroughly experienced in planning, designing, specifications, purchasing; amiable labor supervisor. Now employed by U.S. government, but desires position offering more responsibility. Available on two weeks' notice. C-846.

EXECUTIVE

Executive; Latin America: Assoc. M. Am. Soc. C.E.; American; married; 19 years experience; licensed; fluent Spanish; 11 years in tropics on airports, heavy construction, roads, sewers, housing, industrial buildings, pipe lines, oil fields, transmission lines. Capable organizer and supervisor of Latins. Prefer long-time foreign engagement but will consider other offer. C-843.

JUNIOR

Civil Engineer; Jun. Am. Soc. C.E.; 23; married; B.S.C.E., Texas Agricultural and Mechanical College, 1939; 16 months experience in soils laboratory assisting in routine raw soil tests and experimental asphalt and cement stabilization tests, also density control on embankment construction; 7 months with resident engineer on highway construction including concrete batching plant. C-850.

TEACHING

Assistant Professor; Jun. Am. Soc. C.E.; age 32; married; B.S.C.E., M.S.C.E., and C.E. degrees; registered civil and structural engineer; 11 years teaching experience, mainly surveying and structures; also taught courses in highways, hydraulics, mechanics, and strength of materials one semester; $2^1/_4$ years practical experience in structural detailing, design, surveying, and inspection. C-847.

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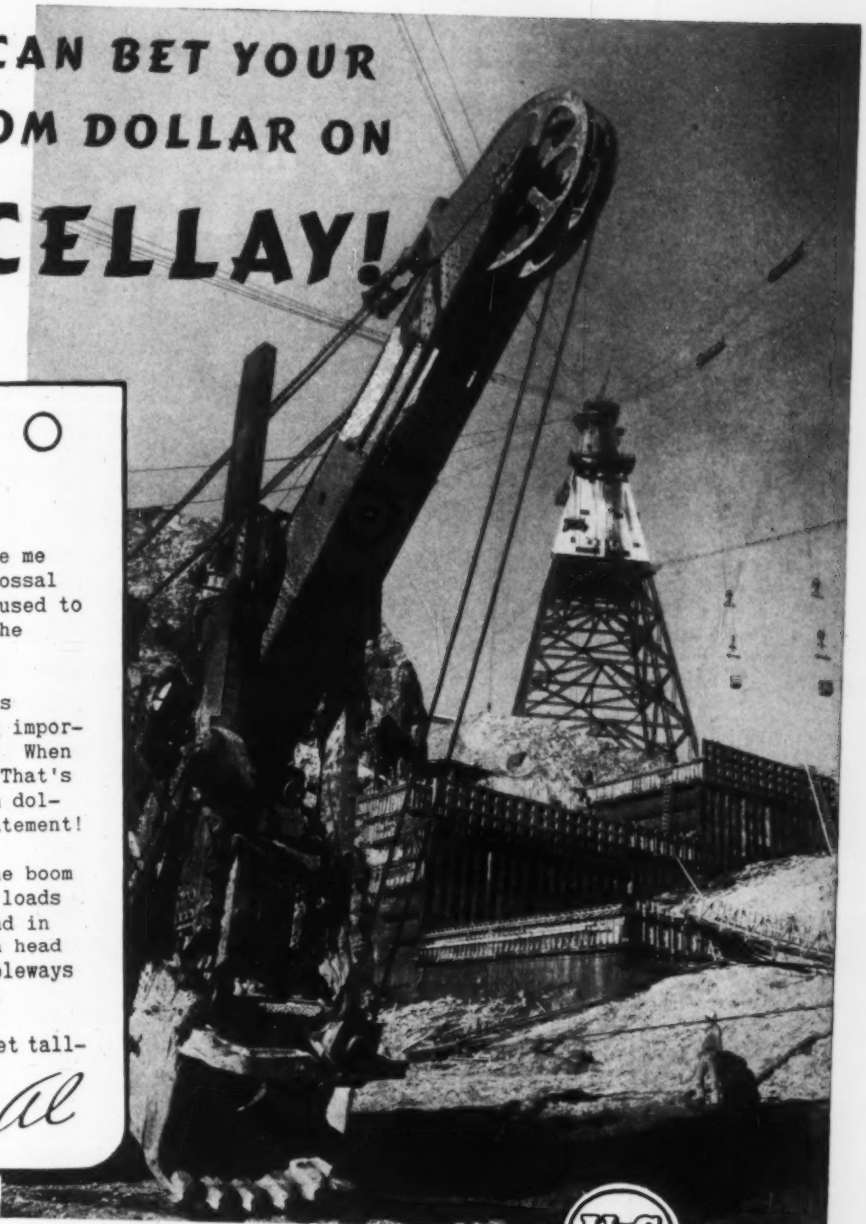

A WIRE ROPE ENGINEER REPORTS TO HIS BOSS

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By the way, the head tower is 25 feet taller than a 31-story building!

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COLUMBIA STEEL COMPANY
San Francisco
United States Steel Export Company, New York

UNITED STATES STEEL

Instruction in Civil or Hydraulic Engineering; Jun. Am. Soc. C.E.; B.S.C.E.; M.S.; C.E.; 8 years successful teaching experience as instructor and assistant professor at one college. Professional experience in flood control and hydrological investigations; $1^1/_2$ years with public utility organization. Would consider teaching or professional opening. C-848.

Professor of Mechanics and Materials; Assoc. M. Am. Soc. C.E.; registered civil, mechanical, and structural engineer and surveyor; graduate study beyond M.S. degree in C.E.; 8 years engineering practice, including design and supervision; 15 years teaching mechanics, materials, surveying, drafting, structures, and as department head. Will consider executive responsibility or specialized teaching in mechanics and materials. C-849.

Civil Engineer; Assoc. M. Am. Soc. C.E.; registered civil engineer and land surveyor; B.S. and M.S. in C.E.; desires teaching position; six years teaching experience including two years as assistant professor; taught surveying, engineering drawing, highway engineering courses, hydraulics, reinforced concrete, and mathematics. Considerable experience in surveying, construction, and drafting. C-851.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

American Society for Testing Materials, Proceedings of the 43d Annual Meeting, held at Atlantic City, N.J., June 24–28, 1940, Vol. 40, 1940. American Society for Testing Materials, Philadelphia. 1396 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $9.

The major part of this large annual volume is devoted to the technical papers, including discussions, presented before the society during the year indicated. The book also contains the summary of the proceedings of the annual meeting and the reports of the various technical committees.

American Year Book, a Record of Events and Progress, Year 1940. Edited by W. M. Schuyler and A. B. Hart. Thomas Nelson & Sons, New York, 1941. 1079 pp., tables, 8 × 5 in., cloth, $7.50.

This annual presents a survey by recognized authorities of events during the year 1940 in twenty-seven major fields of activity. Economics, business, and science are represented, including surveys of the mineral industries, manufactures, transportation, mathematics, chemistry, physics, engineering, and construction. The material is contributed by recognized authorities. Lists of related periodicals, societies, and research institutions accompany each section, and there is a comprehensive index.

Air Raid Precautions Handbook No. 11, **Camouflage of Large Installations**. His Majesty's Stationery Office, London. 15 pp., illus., $6^1/_2$ × 4 in., paper. (Obtainable from British Library of Information, 50 Rockefeller Plaza, New York, 10 cents.)

This pamphlet describes in general terms the measures that may be taken by means of camouflage to render factories and other buildings less distinguishable from the air. Illustrations and color plates are included.

Civil Air Defense. By Lt. Col. A. M. Prentiss. Whittlesey House (McGraw-Hill), New York, 1941. 334 pp., illus., tables, diagrs., charts, 9 × 6 in., cloth, $2.75.

Colonel Prentiss describes the various means and methods of air attack and the effects produced by each, and discusses in detail protection against high explosives, incendiaries, and the different kinds of gases. He describes the various services that must be provided for the protection of the public and discusses the probable influence of civil air defense on our national life and the future development of our large cities.

Descriptive Geometry. By A. S. Levens and H. C. T. Eggers. Harper & Brothers, New York and London, 1941. 240 pp., illus., diagrs., charts, tables, $9^1/_2$ × 6 in., cloth, $2.50.

A full presentation of both graphic and algebraic methods of descriptive geometry provides a double check on solutions and achieves a correlation between descriptive and analytical geometry. In addition to the general coverage of fundamentals there is a long chapter on present-day practical applications in various technical fields.

Engineering Kinematics. By A. Sloane. Macmillan Co., New York, 1941. 310 pp., illus., diagrs., charts, tables, $9^1/_2$ × 6 in., cloth, $4.

Intended for use as a college course to fit in between the principles of applied mechanics and machine-design practice, this textbook discusses thoroughly the fundamentals of displacement, velocity, and acceleration as the common background of all mechanisms. The various types of mechanisms are used as illustrations of basic principles and as a source of practical problems.

Fares, Please! From Horse-Cars to Streamliners. By J. A. Miller. D. Appleton-Century Co., New York, 1941. 204 pp., illus., woodcuts, 10 × 6 in., cloth, $3.50.

The author gives a picture of city transit from the time of the first horse-drawn omnibus to the present day. The various means of transport, including their development, their problems, and the personalities involved, are described in separate chapters. Unusual types of transit and the methods used to meet transportation problems in crowded cities are also discussed. There are many illustrations.

Fluid Mechanics. By G. N. Cox and F. J. Germano. D. Van Nostrand Co., New York, 1941. 274 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $3.

This practical textbook on the behavior of fluids, intended to prepare engineering students for problems encountered in the industrial field, covers both liquids and gases. The text is divided roughly into five parts: hydrostatics, measurement, transportation and dynamics of fluids, and centrifugal pumps. The necessary basic theoretical treatment is included, and there are many problems from actual practice.

Highway Safety and Automobile Styling. By A. W. Stevens. Christopher Publishing House, Boston (Mass.), 1941. 155 pp., diagrs., 8 × 5 in., cloth, $1.75.

The author describes the general conditions of highway travel, points out various factors of importance in causing accidents, and suggests remedies. The emphasis is on the redesign of automobiles to put the driver at the very front of the car, in order to increase visibility. The conclusions are the result of a six-year investigation of the problem.

Hydraulic Measurements. By H. Addison. John Wiley & Sons, New York, 1941. 301 pp., illus., diagrs., charts, tables, 9 × $5^1/_2$ in., cloth, $5.

This is a manual of hydraulic measuring technique, intended to be of practical utility both in the laboratory and in making measurements under service conditions. The whole range of measurements is covered, and a great variety of methods and apparatus is considered critically. A glossary and bibliography are appended.

Los Angeles: Preface to a Master Plan. Edited by G. W. Robbins and L. D. Tilton. Publication XIX of the Pacific Southwest Academy, Los Angeles (Calif.), 1941. 303 pp., illus., maps, charts, tables, 9 × 6 in., cloth, $3 (paper, $2).

Looking toward the future development of the area, a specially appointed Pacific Southwest Academy committee outlined the pattern of this critical and interpretative study of Los Angeles. Such problems as land use, housing, zoning, industrial growth, traffic, and transportation are discussed by twenty-one authorities in the various fields. Photographs, charts, maps, and tables are used to illustrate the topics considered.

Mathematics for Engineers, 2 ed. By R. W. Dull. McGraw-Hill Book Co., New York and London, 1941. 780 pp., diagrs., charts, tables, $8^1/_2$ × $5^1/_2$ in., cloth, $5.

This work affords a convenient review of those phases of mathematics that are especially important in engineering work, and is intended for use as a practical reference work or as a text for private study. The chapter on the slide rule has been extended in this edition, and minor changes have been made throughout the text.

Mechanism, Fundamental Theory of the Modification and Transmission of Motion. By S. E. Winston. American Technical Society, Chicago, Ill., 1941. 372 pp., illus., diagrs., charts, tables, $8^1/_2$ × $5^1/_2$ in., cloth, $3.50.

This book deals with mechanical movements and the combinations of links or machine elements by which these movements are modified and transmitted. The use of the graphical method for analyzing relative motions allows a simple mathematical treatment. Review questions and problems accompany each chapter.

Outlines of Structural Geology. By E. S. Hills. Nordemann Publishing Co., New York, 1940. 172 pp., illus., diagrs., maps, $7^1/_2$ × 5 in., cloth, $2.25.

In this small volume the author presents "a brief, yet reasonably complete...summary of structural geology, with special reference to those aspects of the subject with which the field geologist should be acquainted." The text is well-documented and is illustrated by numerous descriptive diagrams.

Public Administration Organizations—A Directory, 1941. Public Administration Service (1313 East 60th Street), Chicago, 1941. 187 pp., $9^1/_2$ × 6 in., cloth, $1.50.

This is the fifth edition of *Public Administration Organizations*, a directory of voluntary unofficial organizations working in the general field of public administration or in fields affecting public administration. The directory lists and describes 556 national organizations.

Public Utility Economics. By C. W. Thompson and W. R. Smith. McGraw-Hill Book Co., New York and London, 1941. 727 pp., illus., maps, charts, tables, $9^1/_2$ × 6 in., cloth, $4.50.

Designed as a textbook for advanced students in economics and commerce, this book relates the field of public utilities to the broader area of economics of which it is a part. Thus the book seeks to acquaint the student with the place that public utilities occupy within our economic structure, and with the special problems of price control, service supervision, security regulation, etc.

(The) Stereographic Projection. By F. W. Sohon. Chemical Publishing Co., Brooklyn (N.Y.), 1941. 210 pp., illus., diagrs., charts, tables, 9 × $5^1/_2$ in., cloth, $4.

The subject is developed fully from its fundamental concepts to its practical use in various scientific fields such as astronomy, mapping, crystallography, hydrodynamics, and seismology. The mathematical relations are fully considered, and some new theorems, developed by the author, have been included. Because of the new theorems a new set of tables of recomputed elements for the use of seismologists has been prepared and is appended.

Structural Drafting. By C. T. Bishop. John Wiley & Sons, New York, 1941. 287 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $3.50.

This book has been prepared especially to meet the requirements of engineering students and structural draftsmen. It corresponds in scope to the duties of the structural-steel draftsmen in the preparation of detailed working drawings for the members of steel structures. Drawings for concrete and timber structures are also discussed briefly, and billing practice is covered. There are many detailed illustrations, and a glossary of engineering terms is provided.

Subdivision Regulations. An Analysis of Land Subdivision Control Practices. By Harold W. Lautner. Public Administration Service (1313 East 60th Street), Chicago, 1941. 346 pp., tables, figures, $9^1/_2$ × $6^1/_2$ in., cloth, $3.75.

This volume presents the first comprehensive analysis of plotting regulations both past and present. In preparing the work, use was made of 284 regulations and about 200 communications from public officials. The primary aim was to present the planning goal of each different kind of regulation, show if possible the strong and the weak points of the regulations already in effect and, when feasible, suggest the type of regulation most likely to accomplish the desired result.

Theory of Simple Structures, 2 ed. By T. C. Shedd and J. Vawter. John Wiley & Sons, New York, 1941. 505 pp., illus., diagrs., charts, tables, $9^1/_2$ × 6 in., cloth, $3.75.

This textbook for engineering students is intended to develop ability to solve problems in structural analysis by giving the student a thorough understanding of the underlying principles. A simple but complete discussion of the essential fundamental laws of statics and their application to simple structures is given, including many problems. The last two chapters present an introduction to statically indeterminate structures.

Traffic Management, Industrial and Commercial, revised edition. By G. L. Wilson. D. Appleton-Century Co., New York, 1941. 453 pp., diagrs., charts, tables, 9 × 6 in., cloth, $3.50.

This comprehensive work on industrial and commercial freight handling and shipping outlines the nature and scope of the traffic manager's functions, describes each part of his work in detail, and discusses the organization and administration of the traffic department for efficient working. In the revision particular attention has been paid to changes in the law and in freight claims.

(The) Wheeler Project. Technical Report No. 2 of the United States Tennessee Valley Authority, Knoxville, Tenn. Government Printing Office, Washington, D.C., 1940. 362 pp., illus., diagrs., charts, tables, maps, 9 × 6 in., cloth, $1.

A brief history of the Tennessee River development and the part played by the Wheeler Project introduces this comprehensive report. The project investigations, including social and economic studies, the engineering design and construction work, initial operations, and reservoir adjustment are described. There is a complete summary of construction costs, and various special reports and test results are appended. A bibliography accompanies each chapter.

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BRIDGES

HIGHWAY, APPROACHES. Girder Span Record Boosted to 271 ft, F. L. Plummer. *Eng. News-Rec.*, vol. 126, no. 13, Mar. 27, 1941, pp. 466–468. Design and construction of Cleveland, Ohio, viaduct approach to Main Avenue Bridge, containing 271-ft plate girder span, crossing railroad tracks at severe skew; details of combination steel and concrete piers anchored to heavy concrete mat placed inside steel sheetpile enclosure; design of girders, erected by locomotive crane and deck traveler working together.

HIGHWAY, GREAT BRITAIN. Leicestershire County Council's Emergency Bridges. *Surveyor*, vol. 98, no. 2553, Dec. 27, 1940, p. 339. Details of design and construction of single-span and trestle-type emergency highway bridges provided for by Leicestershire County Council, England.

HIGHWAY, STRENGTHENING. Strengthening and Widening Highway Bridges, E. E. Brandow. *Pub. Works*, vol. 72, no. 1, Jan. 1941, pp. 9–10 and 35–36. Practice developed by Pennsylvania State Highway Department for strengthening, widening, or entire replacement of highway bridges that do not meet present military requirements.

LIFT, BUENOS AIRES. Nuevo Puente sobre el Riachuelo Presidente "Nicolas Avellaneda." *Ingenieria* (Buenos Aires), vol. 44, no. 793, Nov. 1940, pp. 962–969. New bridge across Riachuelo, to solve traffic problem between federal capital and Province of Buenos Aires; provision is made for automobiles, animal-drawn vehicles, and pedestrians; in normal position, pavement is 21 m above water level, permitting passage of about 97% of vessels; maximum lift to 43 m allows passage of large vessels; escalators for pedestrians; other details.

NATURAL GAS PIPE LINE CROSSINGS. Pipe Line Suspension Bridge. *Gas*, vol. 17, no. 4, Apr. 1941, pp. 19–20. Brief description of type of suspension bridge designed by Oklahoma Natural Gas Pipe Line Company for crossing several sharp banked ravines traversing right-of-way, which were too narrow for ditching beneath channel; piers were made of 8 and 6-in. pipe.

RAILROAD. Inspection of Main Line Bridges, Newfoundland Railway, P. L. Pratley. *Structural Engr.*, vol. 19, no. 3, Mar. 1941, pp. 33–43. Description of Newfoundland Railway with special reference to its bridges; performance of railroad bridges; methods of maintenance and repair.

STEEL TRUSS, PORTSMOUTH, N.H. H-Piles in Hollow-Leg Bents for Bridge Falsework, F. Peirce. *Eng. News-Rec.*, vol. 126, no. 15, Apr. 10, 1941, pp. 529–531. Double-deck highway and railway bridge over Piscataqua River at Portsmouth, N.H., having total length of nearly 2,800 ft, at location where swift tides and deep water made falsework erection difficult; solution was to set braced bents of hollow legs on bottom and drive steel H-piles through these legs to rock; piles averaged 100 ft in length; bridge loads were carried on bents and transferred to piles through bolted connection.

SUSPENSION, PAINTING. Painting Golden Gate Cables from New Type Scaffolds. *Eng. News-Rec.*, vol. 126, no. 15, Apr. 10, 1941, pp. 551–552. Description of light-weight scaffolds for painters working on main cables of Golden Gate Bridge decreasing cost of paint maintenance; painting of bridge cables; cost of painting.

SUSPENSION, VIBRATIONS. Vibration Periods at Tacoma Narrows, W. T. Thomson. *Eng. News-Rec.*, vol. 126, No. 13, Mar. 27, 1941, pp. 477–478. Calculating vibration periods of suspension bridges by using simplified equivalent mass systems for bridge elements; observed periods of Tacoma Narrows Bridge for both vertical and torsional oscillation; numerical examples.

SUSPENSION, VIBRATIONS. Wind Oscillations of Suspension Bridges, H. A. Thomas. *Eng. News-Rec.*, vol. 126, no. 15, Apr. 10, 1941, pp. 547–549. Consideration of aerodynamic principles involved in Tacoma Bridge disaster; values of lift and torque coefficients; oscillations in deck systems, eddy currents attaining resonance with natural frequency of deck; apparatus for testing aerodynamic properties of small models simulating floor- and stiffening systems; action of wind on suspension bridge deck.

WOODEN, WASHINGTON. Tall Timber Trestle Built of Bents in 31-Ft Stories. *Construction Methods*, vol. 23, no. 3, Mar. 1941, pp. 46 and 115. Novel methods used in construction of recently completed Baird Creek logging railway bridge, 235 ft high, spanning branch canyon of Coweeman River in eastern Cowlitz County, Washington; structure consists of 250-ft fir pile approach trestle, 480-ft center section of creosoted timber built up from 12-ft 3-hinged arch in 31-ft stories, with bents 30 ft apart and 400-ft fir pile approach trestle.

BUILDINGS

AUDITORIUMS, ACOUSTICS. Control of Acoustic Conditions on Concert Stage, H. Burris-Meyer. *Acoustical Soc. America—J.*, vol. 12, no. 3, Jan. 1941, pp. 335–337. Concert singers and instrumentalists dislike acoustic conditions of most large concert halls and auditoriums; application of new technique that forms acoustic envelope which surrounds singer or instrumentalist but which is isolated completely from audience.

CAMPS, MILITARY, CONSTRUCTION. Thousand Buildings in Five Months. *Eng. News-Rec.*, vol. 126, no. 13, Mar. 27, 1941, pp. 488–491. Methods used in rapid construction of Indiantown Gap camp, near Harrisburg, Pa., including 1,054 buildings: 25 miles of new roads, sewage treatment plant, 22 miles of sewers, 25 miles of water mains, 500,000-gal steel water tank, 34 miles of power distribution lines, and about 300,000 cu yd of grading; construction of frame buildings.

CHURCHES, CONSTRUCTION. Spire of Christ Church Cathedral, Montreal, W. Griesbach. *Eng. J.*, vol. 24, no. 1, Jan. 1941, pp. 7–10. Foundation construction and underpinning work done in connection with erection of new spire of Christ Church Cathedral, Montreal, which is

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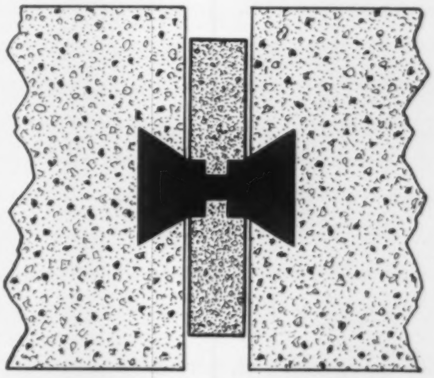

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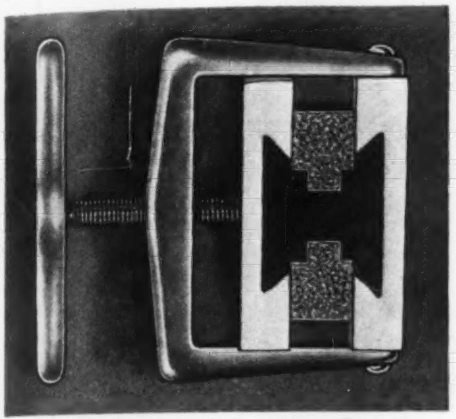
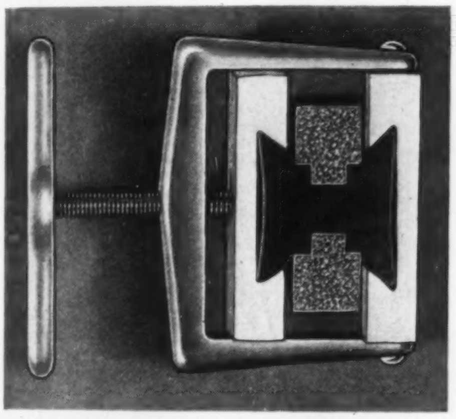


Note Waterstop in normal position. Expansion brings added compression. Seal effected from slab to slab. Compression of fibre intensifies compression of Waterstop.



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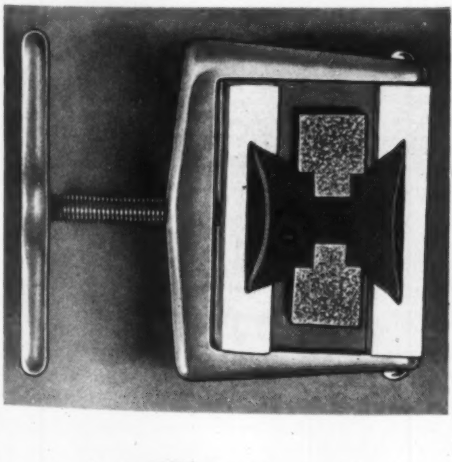

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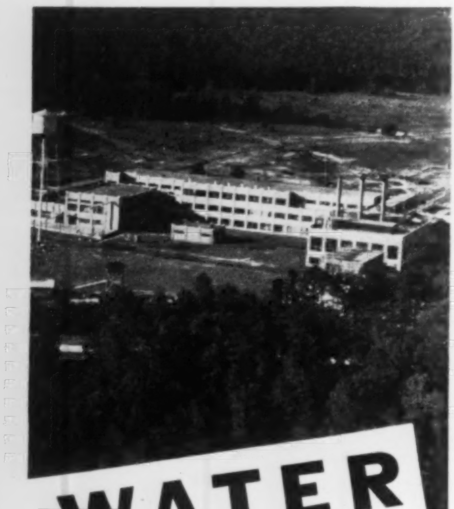

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octagonal in cross section, 24 ft in diameter, and 118 ft high.

FISH HATCHERIES. Essential Features of Bureau's Fish Hatchery at Leavenworth, Wash., S. E. Hutton. *Reclamation Era*, vol. 30, no. 12, Dec. 1940, pp. 342–345. General layout and description of buildings, canals, pipe lines, and other structures of new fish hatchery of U.S. Bureau of Reclamation in Leavenworth, Wash.; operation of fish hatcheries.

PUBLIC BUILDINGS, NEW YORK CITY. On Schedule and Within Budget, E. J. McGrew, Jr. *Eng. News-Rec.*, vol. 126, no. 13, Mar. 27, 1941, pp. 470–474. Planning and coordination of field operations in construction of new city hall for Borough of Queens, New York, in 8 months and within cost estimate of $1,990,000; functional design, with minimum of embellishment, providing structure at cost of 45 cent per cu ft including all engineering and architectural costs; successful plan for budget control.

CITY AND REGIONAL PLANNING

STREET TRAFFIC CONTROL. Traffic and Urban Decentralization, C. T. McGavin. *Nat. Mun. Rev.*, vol. 30, no. 1, Jan. 1941, pp. 28–34. Illustration of how traffic situation is taking part in movement of urban decentralization; traffic requirements and parking problems reviewed.

CONCRETE

COLUMNS. Columns with High Yield Point Reinforcement Designed Under A.C.I. Code, T. Germundsson. *Am. Concrete Inst.—J.*, vol. 12, no. 5, Apr. 1941, pp. 569–574. Discussion of improved design of column supports by adopting reinforced concrete columns of smaller size and uniform cross section, 20 in. being considered optimum size for all columns carrying up to 1,000,000 lb; standardization of design; detailing and erection of floor construction on various levels; details of erection.

CONSISTENCY. Consistent Inconsistencies in Consistency of Concrete, C. H Scholer. *Am. Concrete Inst.—J.*, vol. 12, no. 5, Apr. 1941, pp. 537–548. Discussion of necessity and desirability of concrete segregation and "bleeding"; factors influencing segregation; maximum permissible size of coarse aggregate to be used in given type of construction; segregation required for proper finish; radius of segregation and its significance in complicating placement of concrete; uses of bleeding; density of concrete, as measure of concrete quality.

CONSTRUCTION, COLD WEATHER. Salamanders and Tarpaulins Protect Winter Concrete. *Construction Methods*, vol. 23, no. 3, Mar. 1941, pp. 66 and 113–115. Use of temporary fabric enclosures heated by salamanders to keep concrete warm for construction of grade-separation bridges and other structures of Hutchinson River Parkway Extension, near New York City, 3.9 miles in length; arch protection.

CONSTRUCTION, FORMS. Cantilever Forms at Friant Dam. *Eng. News-Rec.*, vol 126, no. 15, Apr. 10, 1941, pp. 542–543. Description of successful cantilever forms at Friant Dam, utilizing connection just above previously placed concrete to take outward load and special jack and tie at bottom of vertical cantilever member to provide properly alined forms without interior ties.

CONSTRUCTION, FORMS. Wyoming Uses Absorptive Form Lining, R. C. Pike. *Western Construction News*, vol. 16, no. 3, Mar. 1941, pp. 73–76. Use of absorptive lining for concrete forms for four grade-separation structures of Wyoming State Highway Department, to reduce crazing in concrete surfaces and present pleasing finished texture; description of structures; form construction; protection of forms; construction joints; concrete placing and vibrating; form removal, finishing and curing; costs.

MIXING. Design and Control of Paving Concrete in Iowa, B. Myers. *Am. Concrete Inst.—J.*, vol. 12, no. 5, Apr. 1941, pp. 577–588. Discussion of practices of Iowa Highway Commission, over past 20 years, in design and control of paving concrete; design of proportions to make most economical use of aggregates available; practice of weighing aggregates for paving concrete; improvements in methods for control of thickness of pavement slab; design of equipment for accurate control of measurement of mixing water; methods for control of proportions. Bibliography.

READY MIXED PLANTS, ILLINOIS. Concrete for War Industry. *Rock Products*, vol. 44, no. 4, Apr. 1941, pp. 59–60. Notes on batching plant with capacity of 200 cu yd per hour, set up to supply 200,000 cu yd of concrete for Kankakee Ordnance and Elwood Ordnance plants near Wilmington, Ill.; thirty 5-cu yd mixer trucks will be used to make deliveries.

ROADS AND STREETS. Patching Spalled Areas with Cement Mortar, H. F. Clemmer. *Roads & Streets*, vol. 84, no. 3, Mar. 1941, pp. 46 and 48. Report on excellent results obtained by Department of Highways of District of Columbia in patching shallow spalled areas in concrete pavements with cement mortar, using 1:2 mix with very low water content and calcium chloride as accelerator.

CONSTRUCTION INDUSTRY

UNITED STATES. Twenty-second Annual Convention Associated General Contractors of America. *Constructor*, vol. 23, no. 3, Mar. 1941, pp. 39–75. Proceedings of 1941 annual convention of Associated General Contractors of America, including following addresses: Program for National Defense, W. H. Harrison; Man with Contract, B. Somervell; This Year's Outlook for Public and Private Construction, T. S. Holden; Place of Construction Equipment Manufacturer in Defense Program, C. A. Koehring; Relation of Highways to Defense Program, H. K. Bishop; We Learned a Lesson, R. L. Bobbitt; Labor's Part in National Defense, J. P. Coyne; Railroad Construction Markets, J. G. Brennan; National Defense and Regular Construction of Corps of Engineers, J. L. Schley; Navy Defense Construction, L. N. Moeller; War Department and Defense Construction, J. W. N. Schulz; Reclamation, Stabilizer, J. C. Page.

DAMS

CONCRETE, ARGENTINA. Dique San Roque, R. E. Ballester. *Ingenieria* (Buenos Aires), vol. 44, no. 793, Nov. 1940, pp. 970–976. San Roque Dam, for control and regulation of Primero River, to replace old dam built in 1889, with glory-hole spillway 35.3 m above river bed; regulation capacity will be 200,000,000 cu m; crest 43 m high will give supplementary capacity of 150,000,000 cu m; construction begun in October 1939; river is utilized for irrigation in upper Cordova, drinking water supply, and hydroelectric power generation.

CONCRETE, CRACKING. Concrete Deterioration at Parker Dam, R. F. Blanks. *Eng. News-Rec.*, vol. 126, no. 13, Mar. 27, 1941, pp. 462–465; see also editorial comment p. 461. Discussion of random-pattern cracking on exposed surface of Parker Dam concrete, attributed to adverse chemical reaction between alkalis of cement and siliceous minerals in aggregate; development of cracks; internal expansion and surface shrinkage of concrete shown by records from instruments installed in drill holes; basic research needed.

CONCRETE GRAVITY, TENNESSEE VALLEY AUTHORITY. Cherokee Dam on Holston River. *Eng. News-Rec.*, vol. 126, no. 9, Feb. 27, 1941, pp. 333–335. Methods and equipment used in current construction of Cherokee Dam of Tennessee Valley Authority, which will consist of concrete gravity spillway section 175 ft high, 412 ft long, flanked by gravity non-overflow sections on either side, length 1,277 ft, and impervious rolled-fill embankments extending for length of 5,030 ft, thus making total length of dam about 6,750 ft; forms and concrete placing.

CONCRETE GRAVITY, TESTING. Technical Investigations at Boulder Dam, T. C. Mead. *Reclamation Era*, vol. 30, no. 6, June 1940, pp. 162–165. Discussion of special equipment and methods developed for observing performance of Boulder Dam under service conditions, including measurement of forces acting on dam and their effects; observations of seepage; study of salinity, temperatures, density currents, and silt deposition in Lake Mead; resistance thermometer equipment; tiltmeter readings; deformation of downstream face of dam; taking water samples.

EARTH, COLORADO. Green Mountain Dam. *Western Construction News*, vol. 16, no. 3, Mar. 1941, pp. 78–81. Progress report on construction of U.S. Bureau of Reclamation earth-and-rock-fill dam near Kremmling, Colo., which will have maximum height of 309 ft and volume of 4,350,000 cu yd; stripping and site preparation; character of fill obtained; methods of grading and placing fill.

EARTH, REFRIGERATION PROCESS. Frozen-Earth Dam at Grand Coulee, L. V. Froage. *Mech. Eng.*, vol. 63, no. 1, Jan. 1941, pp. 9–15 and 36. Use of refrigeration system for construction of curved frozen earth dam to prevent intrusion of landslide debris onto site of Grand Coulee Dam, Washington; details of brine system; operation of refrigeration system; dismantling of refrigerating system; structural strength of frozen earth; earth temperatures; financial aspects.

FISH LADDERS. Migratory Fish Control. *Reclamation Era*, vol. 31, no. 1, Jan. 1941, pp. 1–6. Discussion of special structures and arrangements made at several recent U.S. Bureau of Reclamation dams for solving migratory fish control problems; fish traps at Rock Island Dam; auxiliary hatcheries; screens and by-passes; fish ladders.

FISHWAYS. Transporting Migratory Salmon and Steelhead of Upper Columbia River, S. B. Hill. *Reclamation Era*, vol. 30, no. 6, June 1940, pp. 175–178. Methods and structures developed by U.S. Bureau of Reclamation for transporting fish runs upstream of high dams, including traps and loading devices at three fish ladders, holding ponds, hatcheries, and rearing ponds; fish trucks; fish hauling; water temperature control; losses in hauling and after hauling.

FLOW OF FLUIDS

FLOW OF WATER, OPEN CHANNELS. Turbulence in Open Channel Flow, A. A. Kalinske and J. M. Robertson. *Eng. News-Rec.*, vol. 126,

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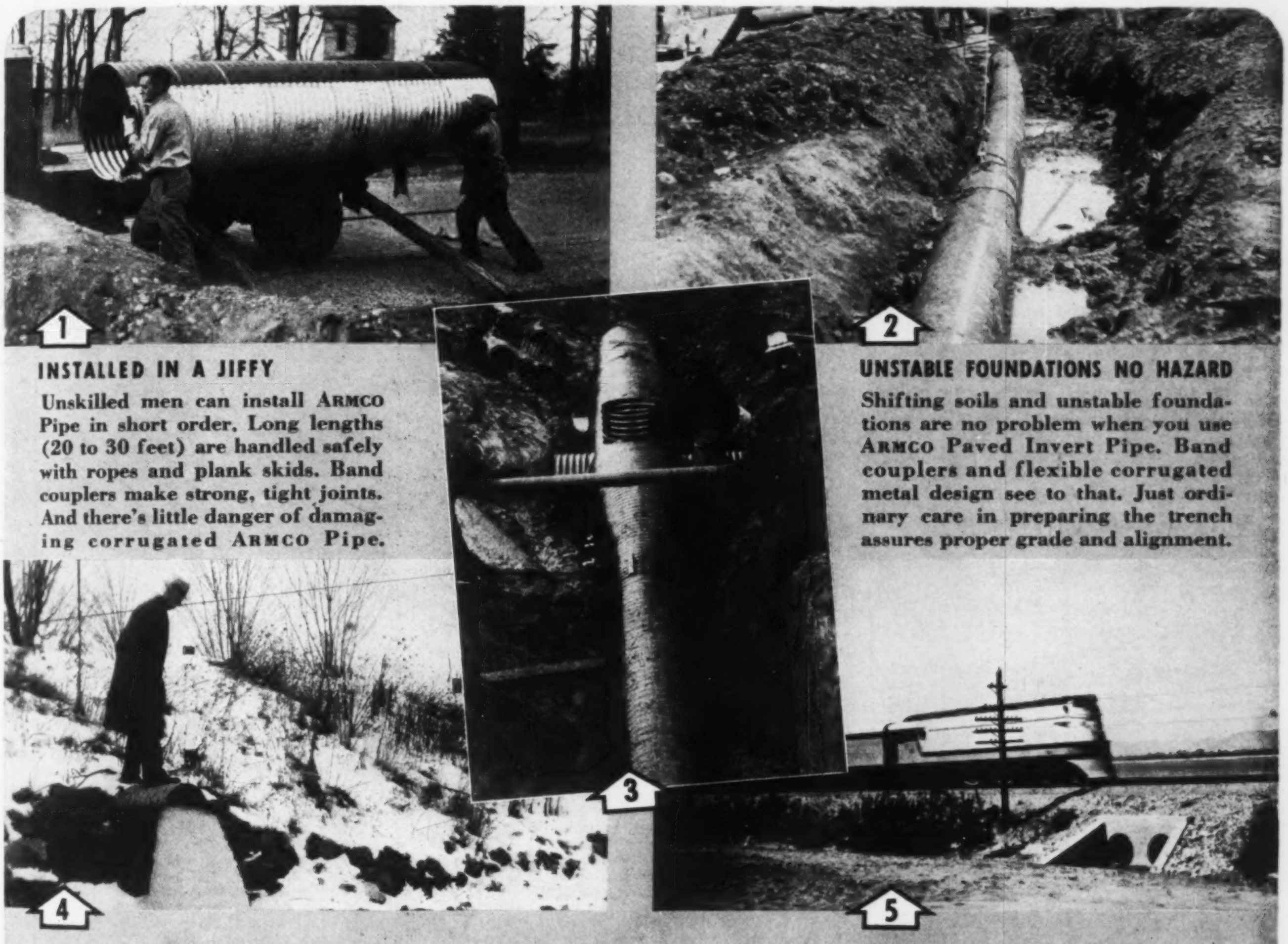

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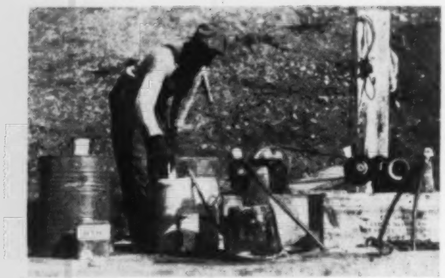

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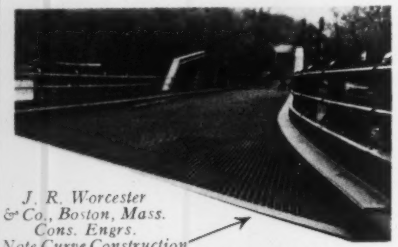

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no. 15, Apr. 10, 1941, pp. 539–541. Report from Iowa Institute of Hydraulic Research on laboratory experiments which provided means of direct quantitative measurement of turbulence diffusion, revealing new information on sediment transportation in streams; theory of diffusion in turbulent flow; motion picture study of turbulence; variation of diffusion coefficients and mean velocity; comparison of vertical and lateral diffusion coefficients.

FLOW OF WATER, UNDERGROUND. Elektrische Messung kleinster Grundwassergeschwindigkeiten, K. Schweigl and V. Fritsch. *Gas- u Wasserfach*, vol. 83, nos. 39 and 40, Sept. 28, 1940, pp. 481–485, and Oct. 5, pp. 501–504. Principles of electric method of measuring flow of water underground; description of apparatus used; results of underground water survey at Tetschen-Liebwerd Agricultural College in Sudetenland; where ground-water flow of 20 cm per 24 hours was determined.

FOUNDATIONS

BEARING POWER. Der Neubearbeitung der DIN 1054, Richtlinien fuer die zulaessige Belastung des Baugrundes und der Pfahlgruendungen," zum Geleit. Casagrande. *Bautechnik*, vol. 18, no. 49, Nov. 15, 1940, pp. 561–562. Discussion of revised text of German standard DIN 1054, dealing with permissible loads on foundation sites and pile foundations.

SHEET PILING. Grundsaetzliches ueber die Berechnung von Spundwaenden, E. Jacoby. *Bautechnik*, vol. 19, no. 8, Feb. 21, 1941, pp. 88–94. Theoretical mathematical discussion of principles of design of sheet-piling walls; effect of earth pressure and cohesion of earth mass; friction between sheet-piling wall and earth; design of anchored walls subjected to concentrated load or to earth pressure. Bibliography.

STREET CLEANING AND REFUSE DISPOSAL

SNOW REMOVAL, EQUIPMENT. Snow Removal Equipment and Ice Control, C. M. Upham. *Eng. & Contract. Rev.*, vol. 53, no. 49, Dec. 4, 1940, pp. 9–11 and 31–32. Road design provisions for snow removal, including fencing for prevention of encroachment of snow drifts; features of recent types of snow plows; use of radio communication for snow removal and ice control operations. Before Can. Good Roads Assn.

STRUCTURAL ENGINEERING

ANTI-AIRCRAFT PRODUCTION, SHELTERS. Reinforced Concrete Air Raid Shelters. *Engineer*, vol. 170, no. 4431, Dec. 13, 1940, p. 382. Brief illustrated description of shelter known as "Raidsafe," made up in sectional units, one end section having concrete door cast in steel frame fitted in it; opposite end is generally left as blank end; whole shelter is one ft thick in concrete, and is intended to withstand debris load of at least 1,000 lb per section ft.

ANTI-AIRCRAFT PROTECTION. Air Raid Damage in London, O. Bondy. *Eng. News-Rec.*, vol. 126, no. 9, Feb. 27, 1941, p. 317. Letter to editor commenting on effect of aerial bombing on brick buildings and steel structures, and deformation of steel under blast and impacts.

BEAMS, CONTINUOUS. Continuous Beams and Rigid Frames, A. Fruchtlander. *Concrete & Constr. Eng.*, vol. 35, no. 12, Dec. 1940, pp. 577–591, and vol. 36, no. 1, Jan. 1941, pp. 45–54. Revised presentation of Hardy Cross moment distribution method, bringing it back to traditional algebraic domain and giving it general mathematical form; analysis of three continuous spans monolithic with columns; analysis of continuous spans monolithic with columns; numerical examples.

JOINTS, WOODEN. Construction Design Chart—LXI—Pressure on Inclined Timber Surfaces, J. R. Griffith. *Western Construction News*, vol. 16, no. 1, Jan. 1941, p. 29. Construction of alinement chart for computing allowable pressure on inclined timber surfaces according to Hankinson formula; numerical examples.

PROBLEMS. Some Problems in Structural Engineering, W. C. Cocking. *Structural Engr.*, vol. 19, no. 2, Feb. 1941, pp. 13–18 and 29. Discussion of following problems: safety in construction; stability of reinforced concrete; post-war housing construction; communal heating systems; protection from damage likely to be caused by incendiary bombs.

TUNNELS

CONSTRUCTION. Tunnel Drilling Guide, T. R. Johnson. *Eng. News-Rec.*, vol. 126, no. 11, Mar. 13, 1941, p. 422. Description of special marker equipment for painting drilling guides for 27-ft circular penstock tunnels of Parker Dam powerhouse.

MINES AND MINING. Carlton Drainage Tunnel, A. H. BeBee. *Min. Congress J.*, vol. 27, no. 1, Jan. 1941, pp. 32–35. General description of project which is third drainage bore driven in Cripple Creek area since 1891; main tunnel to extend 6 miles through granite; 4,000 and 5,000-ft laterals will be driven to give complete drainage for Cresson and Vindicator mines; drilling bits; drilling methods and jumbo equipment; "cherry picker" muck car shifter; haulage; ventilation; progress record; costs.

MINES AND MINING. Elton Tunnel Is Nearing Completion, E. W. Harmer. *Min. J.* (Phoenix, Ariz.), vol. 24, no. 20, Mar. 15, 1941, pp. 3–5. Progress notes on driving of 24,300-ft tunnel of National Tunnel and Mines Company to dewater deep workings of Utah-Apex and Utah-Delaware mines, to eliminate hoisting, to reduce transporation costs, and to provide irrigation water for lands in Utah.

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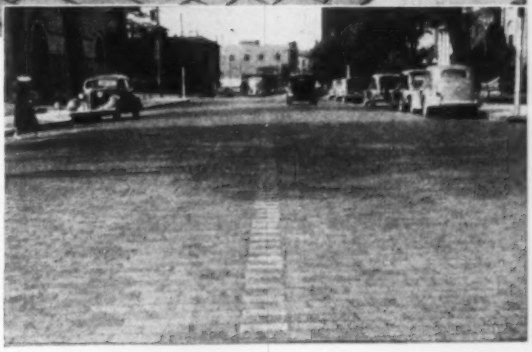

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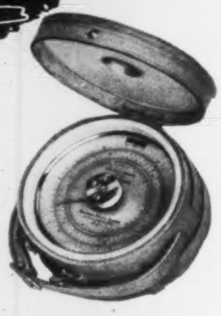

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